Endoscopic Surgery in Rhinology and Ophthalmology

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The rapid development of endoscopic methods in many fields of surgery has been possible by the fiberoptic technique in connection with high-quality video representation and computer-tomograhic imaging. In rhinology, there has been a worldwide adoption of the technique in diagnostics and treatment. In the beginning, the technique was founded on concepts developed after many years of endoscopic investigation and clinical observations by W. Messerklinger and coworkers in Graz, Austria, with later contributions from other European ENT clinicians,[1,2,3] and it was subsequently made popular by Kennedy and colleagues in the United States.[4] Nasal and paranasal sinus endoscopy proved to be a valuable diagnostic contribution to rhinology. Endoscopic sinus surgery (ESS) has also proved suitable for treatment, not only of rhinologic disorders but also for some ophthalmologic and neurosurgical conditions. When properly used, ESS causes much less morbidity than does treatment with older "conventional" surgical methods. In the following discussion, I will briefly cover the pathophysiology of some of the disorders, the surgical indications and technique, as well as the results and complications of this kind of surgery.

Pathophysiology of chronic paranasal sinus disease

According to thorough observations, most infections of the paranasal sinuses seem to start in stenotic areas of the ethmoid labyrinth—especially in its anterior part—which is thought to be the key area of infection of all other adjacent sinuses (Figure 1). Permanent mucosal thickening in the narrow clefts, which is made up of the ethmoidal infundibulum and is near the entrances to the maxillary sinus and the frontal recess (the so-called ostiomeatal complex), is a predisposition for illness in all sinuses when ventilation and mucus drainage are blocked.[4,5] Swollen mucosa and pronounced changes in the nasal mucosal glands—producing a highly viscous mucus—cause a vicious circle of chronic infection, and in some cases, may even explain the development of polypoid disease in the nose and sinuses.

This pathophysiologic chain of events may explain the poor results often seen when using the simple Caldwell-Luc radical operations of the maxillary sinus as the standard surgical treatment of chronic sinusitis, which leaves the focus in the anterior ethmoid intact. The investigations of the Messerklinger group showed that mucus transport in the maxillary sinus is always directed to the natural ostium in the middle meatus of the nose, irrespective of whether the ostium is closed by inflammatory disease, and irrespective of the existence of a surgically opened endonasal window in the lower meatus.[1,5]

Polypoid disease is perhaps the most frequently seen pathologic mucous membrane of the nose and sinuses, and together with chronic infection, it is the most frequent indication for surgical intervention in this area. Most polyps originate in the narrow spaces of the ethmoid. Clinically, a wide spectrum is seen, from small, circumscribed polypoid areas, probably induced by chronic infection, to massive bilateral polyposis, completely filling out the nasal cavities and the paranasal sinuses (Figure 2). The etiology of polyps is not yet understood, possibly with the exception of the so-called "choanal polyps" which have their origin in a cyst in the maxillary sinus. Between 20 percent and 40 percent of patients with chronic asthma suffer from recurring nasal polyposis, as do patients with intolerance to non-steroidal anti-inflammatory drugs (NSAID).[6,7]

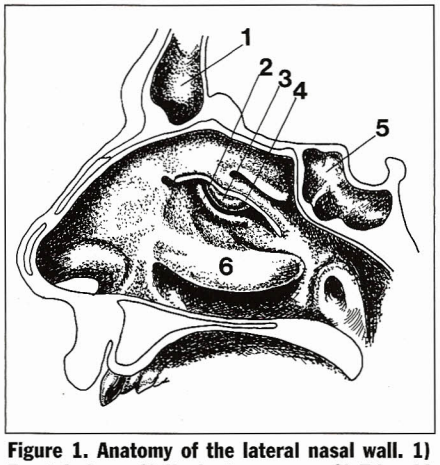

Figure 1. Anatomy of the lateral nasal wall. 1) Frontal sinus, 2) Uncinate process, 3) Ethmoid bulla, 4) Resected edge of middle concha (i.e. "ground lamella"), 5) Sphenoid sinus, 6) Inferior concha. The area between 2 and 4 constitutes the "key area".

Another common "endoscopic" rhinologic disorder, especially in the elderly, is repeated posterior severe epistaxis episodes, which often derive from the most posterior part of the nasal cavities, not seldom from the sphenopalatine artery.

Cystic fibrosis (CF) is an autosomal recessive trait believed to result from a single defect located on chromosome 7. In addition to pulmonary disease, pancreatic insufficiency and an increased sweat chloride concentration, a subgroup of patients suffer from nasal polyposis and chronic sinus disease.[8] It is recommended that any child with nasal polyposis should be screened for CF.[9] Primary ciliary dyskinesia (PCD) is an uncommon inherited, autosomally recessive disease characterized by chronic rhinosinusitis, chronic bronchitis with bronchiectasis, and in 50 percent of cases, situs inversus.[10] Dynein deficiency in the cilia and their consequent immotility is responsible for the clinical syndrome. Congenital choanal atresia, which if unilateral, may remain undiscovered for several years after birth, is a third congenital anomaly suitable for endoscopic surgical treatment.

Pathophysiology of ophthalmologic disorders treatable endoscopically

Of ophthalmologic diseases which can be treated endoscopically, perhaps the most well known is lacrimal obstruction, including chronic dacryocystitis, which is induced by congenital or acquired stenosis of the nasolacrimal duct. Another is progressive exophthalmus induced by dysthyroid orbitopathy,[11] an autoimmune disorder in which antithyroglobulin immune complexes bind to extraocular muscle membranes resulting in inflammation with edema and fibrosis of the extraocular muscles and orbital fat. This, in turn, results in increased orbital pressure and the risk of progressive loss of visual acuity. A third "ophthalmologic" disease is the subperiosteal orbital abscess seen in children—a serious complication of paranasal sinusitis. Bacteria invades into the orbit, mostly from the ethmoids, and if untreated, can result in blindness, meningitis or brain abscess.

Preoperative diagnosis

Nasal endoscopic operative procedures should always be preceded by a thorough clinical evaluation including a careful history of earlier operations, medical treatment courses, known sensitivity to drugs, bleeding disorders etc.,

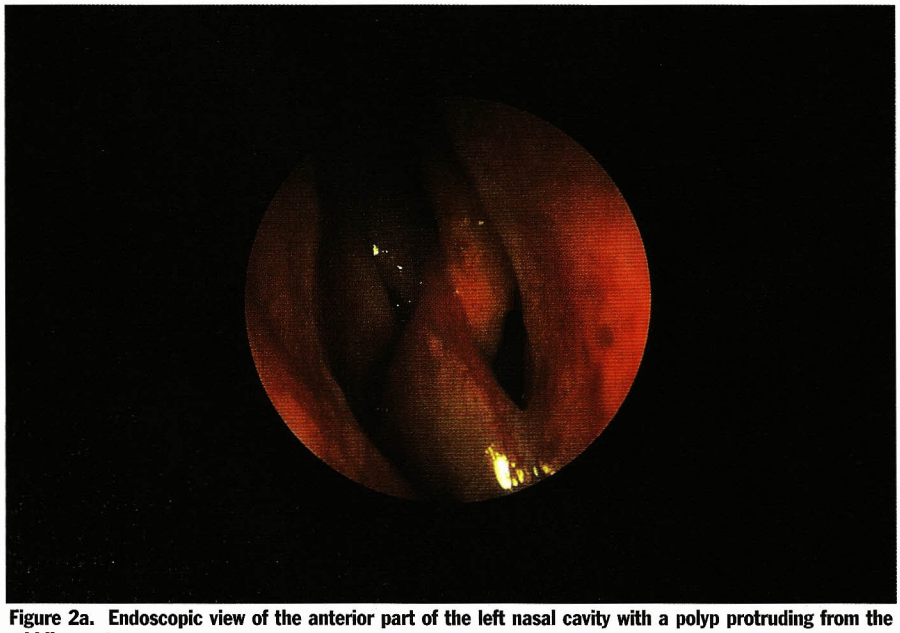

Figure 2a. Endoscopic view of the anterior part of the left nasal cavity with a polyp protruding from the middle meatus.

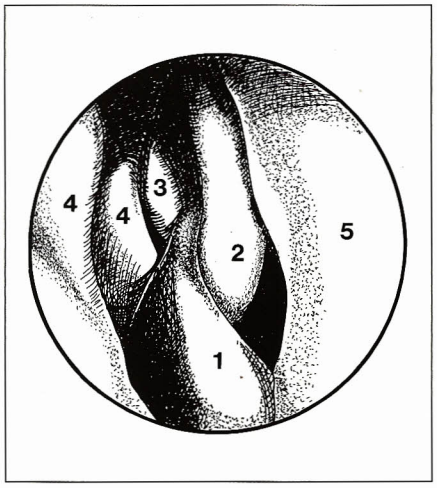

Figure 2b. Schematic diagram of Figure 2 - a. 1) Nasal polyp, 2) Inferior concha, 3) Edge of middle concha, 4) Nasal septum, 5) anterior lateral nasal wall.

and inspection of the decongested nasal cavities. Preoperative endoscopy and CT scanning of the nose and paranasal sinuses have been the prerequisites of the modern, so-called functional ESS.

The routine use of endoscopes in the diagnosis of intranasal disease has enabled greater precision in the diagnosis, as compared to only inspecting with the naked eye or the microscope. Plain radiographs with "normal" maxillary and frontal sinuses are poor diagnostic aids in paranasal sinus disease, as compared with CT scanning (usually used with coronal sections), because in the former technique the ethmoids almost defy evaluation. CT mapping of the intranasal and paranasal sinus anatomy has been a sine qua non, not only for sinus surgery itself but also for its use on ophthalmologic and other indications. It also has strongly contributed to making endoscopic surgery a safe routine procedure.

Surgical indications

In chronic rhinosinusitis/polypoid disease, the indication for surgery, in general, is the persistence of symptoms despite aggressive medical therapy (antibiotics, decongestants, steroids, antihistamines) for an extended period. Surgery should only be performed on radiologic and/or endoscopic evidence of significant sinus disease.

Chronic infections of the paranasal sinuses and chronic nasal polyposis are the most common indications for ESS intervention. The degree of mucosal disease in the maxillary and frontal sinuses does not, however, correlate with the amount of ethmoidal polyps. Even very circumscribed pathology of the anterior ethmoid can give total opacification of these major sinuses.[5] Thus, even a confined procedure in the anterior ethmoid can induce healing of chronic pathologic processes of the major sinus cavities that have gone on for years (Figure 3). In cases of chronic hyperplastic polyposis, surgery must often be more radical with a clearing of all paranasal sinus cavities. Even when objective findings are scarce, patients may have severe complaints of subjective symptoms such as headache, nasal stuffiness, pressure feelings between the eyes, postnasal discharge and anosmia, which can often be relieved by a simple anterior ethmoidectomy and are thus indications for surgery[5](Figure 4).

The endoscopic method admits an approach to the sphenoid sinus with negligible postoperative morbidity, as compared to the possible sequelae associated with conventional methods. The sinus can be opened directly through the nasal cavity or after passing through the posterior part of the ethmoid. In this way chronic isolated sphenoiditis can be treated, or a biopsy from tumors in the region can easily be obtained. In cysts of the maxillary sinus with or without choanal polyps, the technique allows eradication of the cyst. A forceps is introduced through an endonasal opening in the middle or lower meatus, viewed in the endoscope through the middle meatus or the canine fossa. This technique has far fewer side effects than the traditional Caldwell-Luc operation.

A more infrequent indication for endoscopic treatment is the repair of sphenoidal cerebral spinal fluid fistulas after head trauma, tumor surgery or surgery for inflammatory paransal sinus disease. In cases where conservative measures were unsuccessful, the earlier methods of choice were frontal craniotomy or external ethmoidectomy. The disadvantage of a frontal craniotomy is the substantial morbidity associated with the procedure, including permanent anosmia.[12] Endoscopy permits excellent visualization and an atraumatic surgical technique with a high rate of success in such cases.

Inverted papillomas of the nasal mucosal membranes have a tendency to recur, and about 15 percent to 20 percent are reported to undergo malignant transformation.[13] In extensive disease, tumors of this kind are often removed using a lateral rhinotomy incision. However, small papillomas or localized recurrences can often easily be treated using local anesthesia with the endoscopic technique.

Intranasal and ethmoid diseases in children are also well suited to endo-

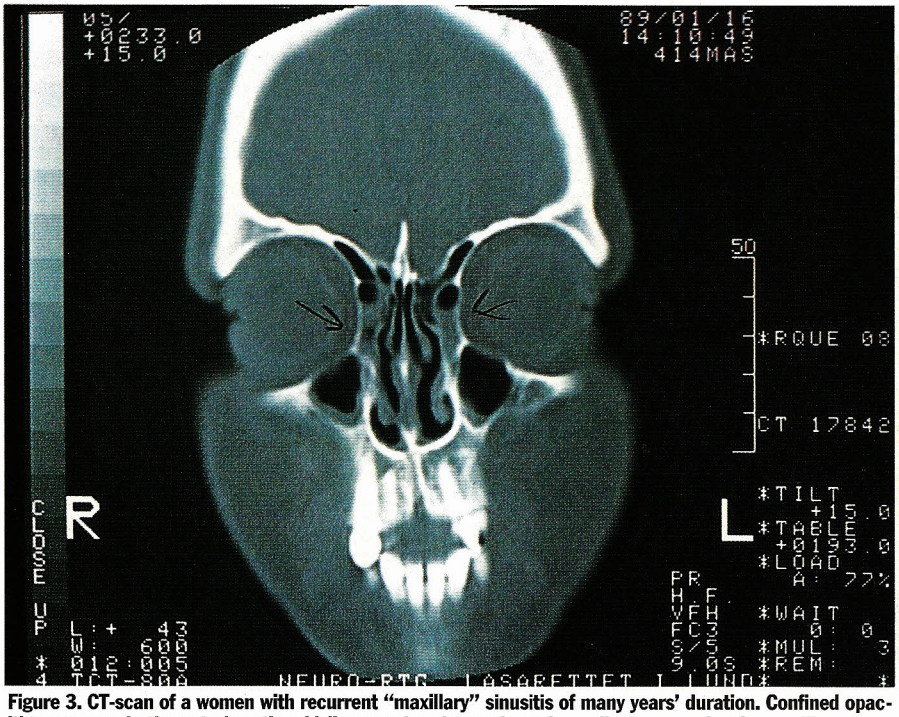

Figure 3. CT-scan of a women with recurrent "maxillary" sinusitis of many years' duration. Confined opacities are seen in the anterior ethmoid (key area) and a moderately swollen mucosa in the maxillary sinus on both sides.

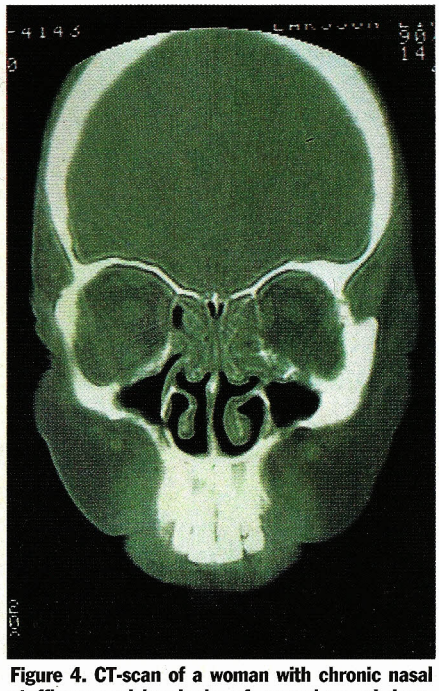

Figure 4. CT-scan of a woman with chronic nasal stuffiness and headache of several years' duration. The ethmoid sinus is obliterated of swollen mucosa on both sides.

scopic procedures. In preschool children, one-sided choanal atresia can be treated endoscopically much more easily than with older approaches, which often include a transpalatinal surgical approach. Other pediatric indications are intranasal polyps, frequently found in children with cystic fibrosis.

Chronic lacrimal obstruction is a frequent ophthalmologic indication for endoscopic intranasal procedures, especially as a revision procedure in cases of recurrence after a Toti operation. An acute subperiosteal orbital abscess can be drained through the middle meatus using the Messerklinger technique.[5] In dysthyroid orbitopathy, decompression of the orbit can be accomplished endoscopically through the nostrils with a minimum of perioperative morbidity.

Instrumentation

The endoscopes used in our clinic are Storz 18-cm long rigid tubes with an outer diameter of 4 mm or 2.7 mm (Hopkins system) angled at 0, 30, 70 or 120 degrees (Figure 5). A wide range of instruments is available, including punches or forceps with different angles, sickle knives, etc. (Figure 6). An Argon laser is also used by some surgeons.

Operative technique

The techniques used at our clinic are those originally described by Messerklinger and Stammberger, with later modifications developed in many ENT centers.[4,5] Mostly in the United States, the original methods have been further refined and used on many other indications than the original ones.

Most of the rhinologic endoscopic operations, such as surgery of the ostiomeatal complex and maxillary sinus, can after adequate premedication be performed under local anesthesia combined with a decongestant. The patient is in the supine position with the surgeon seated on the right side (Figure 7). Topical anesthesia is administered with pieces of cotton soaked in tetracaine and epinephrine, and then squeezed out. The pieces of cotton remain in the middle meatus for a minimum of ten minutes. The uncinate process and the anterior part of the middle turbinate are infiltrated with a local anesthetic (Carbocaine R). The uncinate process is incised at its insertion parallel to the lateral nasal wall, and the process is removed (the first step of the infundibulotomy, according to Messerklinger).[5] The anterior ethmoid and frontal recess can now be reached and any pathology removed.

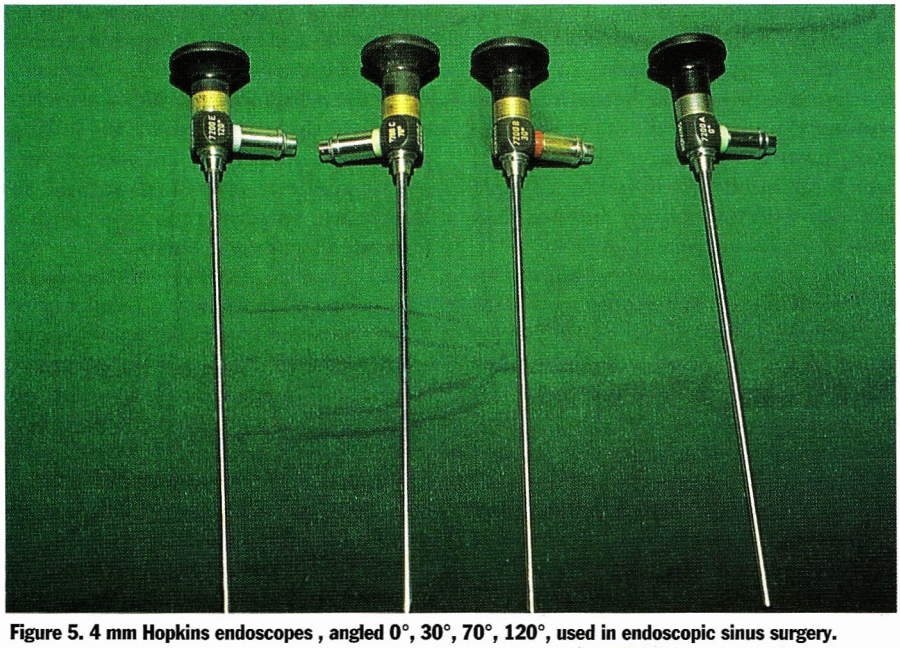

Figure 5. 4 mm Hopkins endoscopes , angled 0°, 30°, 70°, 120°, used in endoscopic sinus surgery.

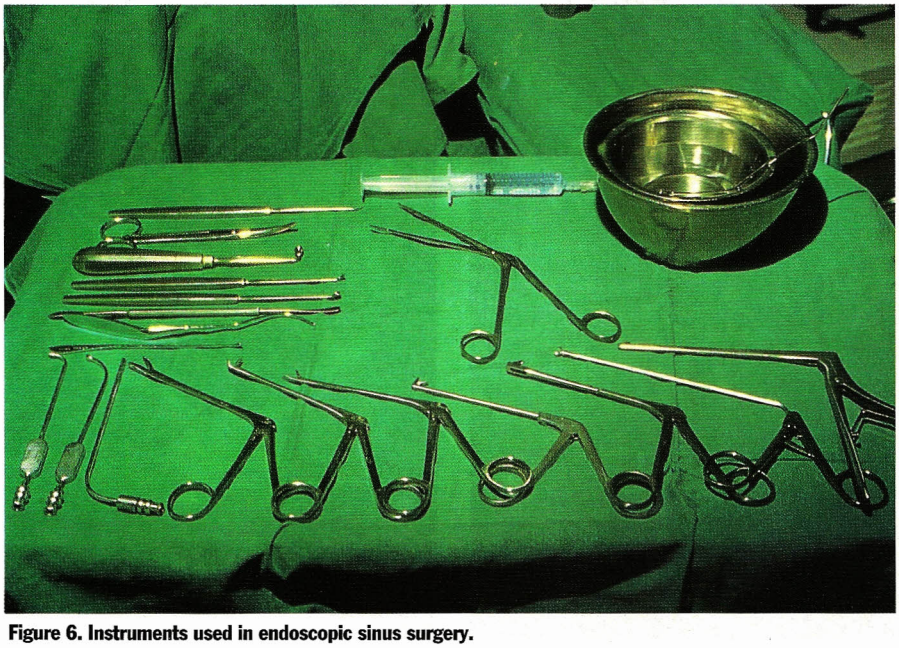

Figure 6. Instruments used in endoscopic sinus surgery.

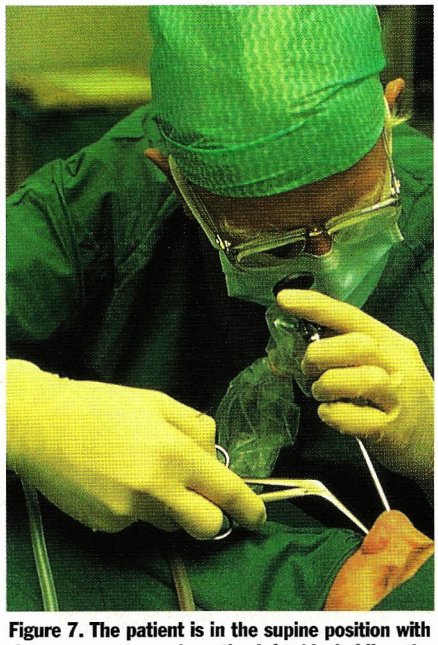

Figure 7. The patient is in the supine position with the surgeon seated on the left side holding the endoscope in his left hand and manipulating the instruments with his right hand.

The ethmoidal bulla can be inspected and opened. If disease is suspected in the posterior ethmoid, the ground lamella of the middle turbinate is perforated and the posterior cells are cleared. The anterior wall of the sphenoid is carefully identified, and if necessary, opened. The ostium of the maxillary sinus is usually blocked by swollen mucosa or polyps, but can be probed and expanded with a bent forceps or a spoon. Through the widened ostium, the maxillary sinus can be inspected and polyps and secretion can be removed.

In extensive diffuse polyposis, general anesthesia might be necessary to enable complete eradication of the disease. With this indication, the surgeon must be very experienced, as most of the anatomic landmarks are often destroyed by the disease. Often the bulk of the polyps must be removed before opening the ethmoid cells, a procedure that is described above. Another way to handle the problem is to start by resecting the posterior part of the middle turbinate at its insertion on the anterior wall of the sphenoid sinus.[14] The sinus wall is then resected up to the skull base. In this way, it may be easier to identify the skull base, which is then followed anteriorly by a step-wise opening of the ethmoidal cells to permit radical removal of the polypoid disease (Figure 8).

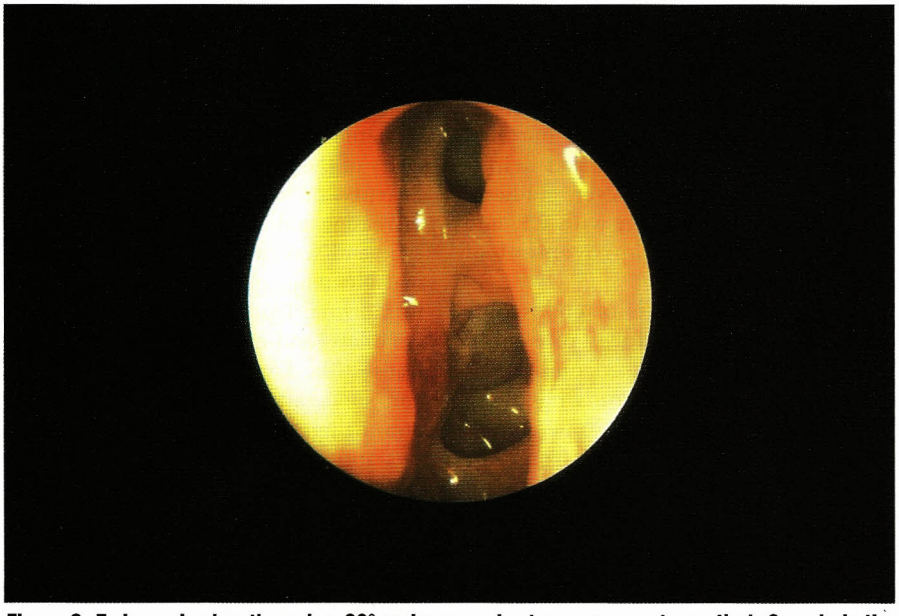

Figure 8. Endoscopic view through a 30° endoscope about one year postoperatively.Superiorly the entrance to the frontal sinus can be seen in the upper field. The ethmoid is totally eradicated and the cavity is covered by normal mucosa.

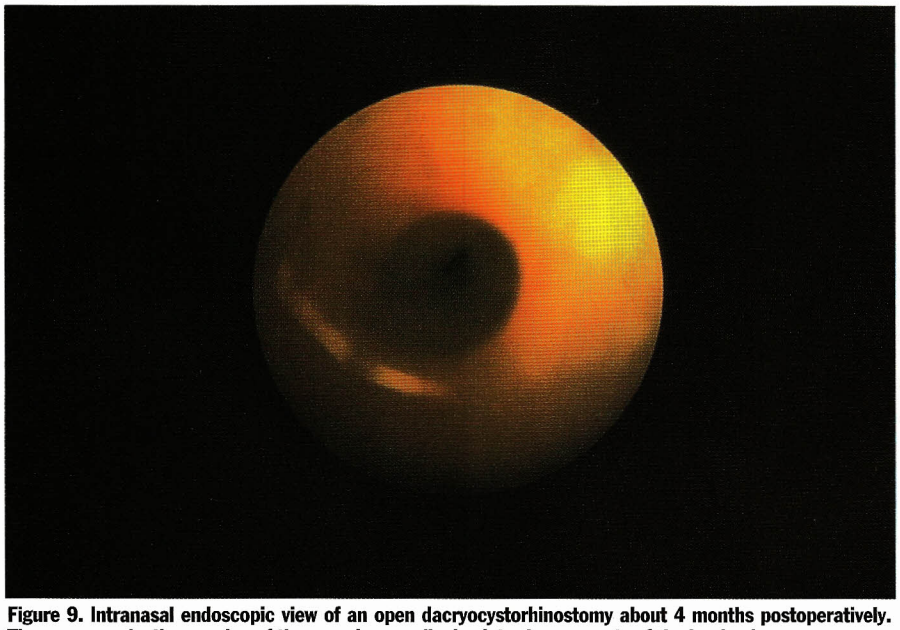

Figure 9. Intranasal endoscopic view of an open dacryocystorhinostomy about 4 months postoperatively. The arrow marks the opening of the superior canaliculus into the remnants of the lacrimal sac.

Minor cerebrospinal fluid leaks occurring during ethmoidectomy can be closed with small grafts of mucous membrane attached with fibrin glue.[12,14] In combination with intrathecal fluorescein, other CSF leaks may also be localized and treated. The mucosa around the leak is carefully elevated, and the graft is placed over the defect and held in place with ointment impregnated Gelfoam®.[12] The packing is removed 5 to 7 days later.

Most experience of endoscopic dacryocystorhinostomy (DCR) derives from secondary revision procedures performed after unsuccessful Toti DCR operations. We use the method described by Metson (15). At operation a septoplasty often needs to be performed. Endoscopically, resection of the anterior part of the middle turbinate and the opening of Agger nasi cells may sometimes be necessary. An assisting ophthalmologist passes lacrimal probes through the canaliculi, which, as seen through the endoscope, are tenting the mucosa of the lateral nasal wall. The endoscopist uses a sickle knife to incise the nasal mucosa anterior to the probe tip. The mucosal flap is then removed. If the lacrimal sac has been entered earlier, the probe tip will be exposed. The intranasal opening is enlarged up to a diameter of about 10 mm (Metson 1991). The lacrimal probe is then replaced by Silastic® tubing passed through the superior and inferior canaliculi into the nose. The tubing is tied outside the nose and can be left in place for at least two months (Figure 9).

Transnasal orbital decompression is best performed in general anesthesia. At our clinic we use the method described by Kennedy.[16] An intranasal sphenoethmoidectomy is performed, according to the principles described above. The medial orbital wall is skeletonized to the fullest possible extent. A very wide middle meatal antrostomy is performed, extending from the lacrimal duct to the posterior limit of the maxillary sinus. The orbital floor is exposed to the infraorbital nerve. The skeletonized medial orbital wall and the bony orbital floor are carefully removed. The exposed periorbita is finally incised in linear strokes with the sickle knife, starting posteriorly. The orbital content herniates out into the middle meatus and into the maxillary sinus, and the effect can be assessed immediately by gently palpating over the orbit (Figure 10).

Results

The results of endoscopic surgery on chronic rhinosinusitis/chronic nasal polyposis presented hitherto have mostly been based on self-evaluations by patients with mixed symptoms. In addition, the follow-up time has been relatively short. Stammberger stresses the lack of criteria for an objective measurement of successful surgery, especially because there is no consistent correspondence between the patient's symptoms and the postoperative endoscopy findings.[5] In a subjective evaluation of 500 patients, 85 percent said that the results of their surgery were very good or good, after a follow-up of 8 months to 10 years.[5] At a 2-year follow-up of 100 patients, Rice found 83 patients had become essentially asymptomatic within weeks to months after surgery.[17] Matthews and coworkers reported that 91 percent of a series of 132 patients "believed that the endoscopic surgery had been beneficial," though complete resolution of symptoms was reported by fewer than 50 percent.[18]

In a group with diffuse polypoid rhinosinopathy, Stammberger found outcome to be distinctly worse than in a group with mixed disease. In the former group, 18 percent of 246 patients had recurrent complaints after only a short interval, even if a more radical approach had been used.[5] Wigand found bronchial asthma and intolerance to NSAID increased the postoperative risk of recurrence in diffuse nasal polyposis, a finding consistent with the results of a study by Jäntti-Alanko in which patients with NSAID intolerance manifested a significantly greater risk of recurrence of polyps after different kinds of nasal and sinus surgery (simple polypectomy, ethmoidectomy).[7,14] The subjective symptoms most commonly relieved after surgery are headache, feelings of pressure between the eyes, nasal congestion, tearing and postnasal drip.[5,14] In many cases patients with bronchial asthma manifest improvement of symptoms and/or a reduction of the need for antiasthmatic medication.

The effects of ESS on the symptoms of CF patients, based on answers to postoperative standard questionnaires and with an average follow-up of 29 months, showed a marked improvement in quality of life with a marked decrease in nasal obstruction, purulent nasal discharge and postnasal drip.[19] The surgery cannot, however, eradicate sinus disease in children with CF, and yields only minor improvement of cough and halitosis.[19]

Although the results of endoscopic revision DCR procedures presented hitherto have been based on a small series, relief of symptoms has been reported in 75 percent to 80 percent of cases with follow-up ranging from 7 to 25 months.[15] The published results of endoscopic decompression in dysthyreoid orbitopathy are promising but have been based on very few cases .[16]

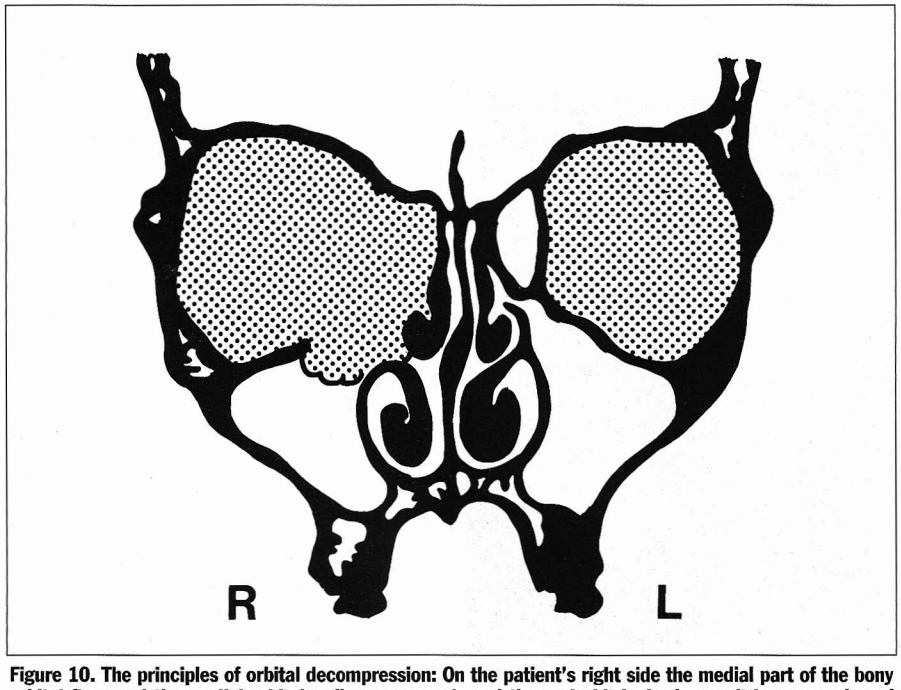

Figure 10. The principles of orbital decompression: On the patient's right side the medial part of the bony orbital floor and the medial orbital wall are removed and the periorbit incised, permitting expansion of the intraorbital content.

In order to improve the evaluation of therapeutic results, several staging systems have been proposed to categorize the extent of different forms of chronic rhinosinusitis pre- and post-operatively. In the future, a system such as that presented by Lund and Mackay, based on CT scan assessment, simple surgical and symptom scores, and a quantification of endoscopic findings, may simplify the problem.[20]

Complications

Mosher stated in 1912 that "intranasal ethmoidectomy is one of the most dangerous and blindest of all surgical operations".[21] Now, the endoscope undoubtedly affords the surgeon an exceptionally clear field of vision, making it much easier to avoid major complications of endonasal ethmoidectomies. Nonetheless, because of the rising popularity of the technique, the volume of literature on complications in ESS is increasing and includes a great variety of type and severity, such as fatal intracranial bleeding, postoperative CSF leaks, intraorbital bleeding with concomitant blindness, and even bilateral optic nerve transection. For this method to be a safe and successful treatment modality in non-malignant disease of the nasal cavities and paranasal sinuses, it is of the utmost importance that the surgeon has an accurate knowledge of the regional topographic anatomy and has been adequately trained by an experienced colleague on a long series of cadaver dissections. The importance of the "learning curve" is reported by Stankiewicz who had 21 complications in his first 51 patients (40 percent) but only 7 in his next 127 patients (5.5 percent).[22] With trained surgeons, the rate of major complications is low. Thus, Vleming reports a complication rate of 4.2 percent in a series of 593 patients (1235 sides operated), with potentially serious complications (orbital hematoma, CSF leaks) in only 0.3 percent of the sides operated.[23] In over 6,000 patients operated on by three surgeons, Stammberger reports only six serious complications (0.1 percent) including three CSF leaks, one pneumatocephalus and two intraorbital bleedings.[5] Because the most serious complications may require urgent decompression of the orbit to avoid loss of vision, or neurosurgical intervention in intracranial lesions, it is important that the ESS surgeon has a clear strategy in mind for immediate implementation should problems arise.

With this proviso, ESS in trained hands may be looked upon as a safe procedure with few risks.

CONCLUSION

When performed by experienced surgeons, after adequate preoperative clinical and radiologic investigation, ESS is a safe procedure with few complications. It is indicated in chronic intranasal and paranasal sinus disease, as well as in some ophthalmologic conditions. Like other endoscopic surgical procedures, it can bring relief to patients who were formerly treated with more invasive surgical methods, and produces much less perioperative morbidity than is associated with conventional, older established methods. Thus ESS causes less suffering and permits earlier postoperative mobilization of the patient. STI

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