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Transnasal ethmoidectomy under endoscopical control

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SUMMARY

Endonasal sinus surgery aims at the preservation of a lining mucosa in the reventilated and redrained cavities. It can, therefore, be confined to the removal of narrowing bone at the "isthmus" of ducts or windows. Transnasal ethmoidectomy for diffuse polyposis consists of the removal of the ethmoidal cell septa, including the middle turbinate, and of a broad fenestration of both the sphenoid sinus and the frontal infundibulum. A consequent postoperative care provided, transnasal ethmoidectomy offers excellent clinical results. A new suction-irrigation endoscope and refined instruments contribute to improved surgical exposure and to the avoidance of complications.

INTRODUCTION

Transnasal sinus surgery began about 1886, when Mikulicz reported on the endonasal fenestration of the maxillary sinus. A second wave of endonasal surgery was initiated by Mosher in 1912, and Halle (1915) who described a transnasal approach to ethmoidectomy. Since that time a much controversial discussion has been brought upon the double pair of alternatives in sinus surgery:

A. External transfacial versus internal transnasal exposure, and

B. Radical eradication versus conservative preservation of cells and mucosa.

So different the opinions are with regard to the reliability of good results, so uniformly all authors do agree up to our days in that surgery of the ethmoid belongs to the most dangerous procedures of our specialty.

I cannot quote all relevant pros and contras of the literature. But, what Sanders has stated in 1964, appears to be still true: "The status of sinus disease in today's practice of Otolaryngology is one of confusion". My own point of view has changed entirely during the last ten years. I was trained in radical operations for chronic sinusitus with meticulous removal of the last piece of the lining mucosa, which was assumed to be irreversibly diseased. But, today, I plead for the preservation of as much mucosa as possible. What only has to be done by the surgeon, can be comprised by a formula which I call "Isthmus surgery":

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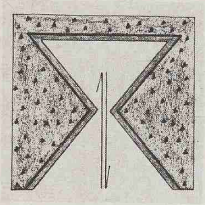
The topography of the paranasal sinuses enhances the development of chronic inflammation, because the reactive swelling of the mucosa will easily block the drainage system at the narrow straits of ducts and windows. This blockage favours chronic infection and infection allergy. A vicious cercle of swelling and obstruction is established, giving rise to the growth of polyps and cysts (Figure 1). To break through this cercle surgery is necessary, but it may be confined to the removal of the isthmus (Figure 2). If we restore ventilation and drainage by opening up the cavities, then the diseased mucosa can recover and will reduce its thickness. This can be evidenced by histological examination before and after the intervention. I have learned from these studies that we cannot predict, at the moment of the operation, which mucosa will heal, and which not. Therefore, we should always give it a chance to recover. With other words: We only remove walls and intercellular septa, take out cysts and polyps, but preserve the lining mucosa of the resulting enlarged cavity, which shall communicate broadly with the nasal air volume.

TECHNIQUE

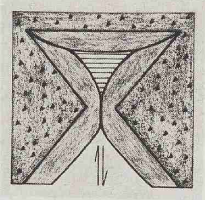
The transnasal approaches to the paranasal sinuses are not new in principle. But what makes them attractive again after many years of discrimination, that are:

1. the mentioned concept of preservation of the lining mucosa in reventilated cavities, and
2. the improved technique.

To 1: Rehabilitation of the mucosa implies not only the operation of the sinus, but requires flanking measures such as outruling of allergy, therapy of immunological defects, removal of foci, e.g. by tonsillectomy, and, first of all, regulation of

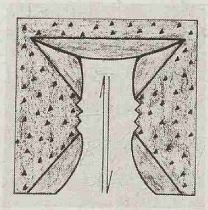


a. Schematic model of a sinus with a thin lining mucosa. Air passage and drainage are free.

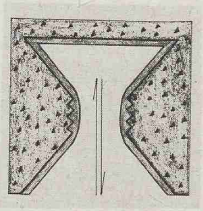


b. Inflammatory thickening of the mucosa blocks the outlet of the sinus.

Figure 1.



a. Surgical removal of bone at the "isthmus" will reestablish ventilation and drainage to the sinus.



b. Recovery of the mucosa evidenced by its normal thickness.

Figure 2.

nasal respiration, what very often means septum correction and conchotomy. Of particular importance is a consequent postoperative treatment of the mucosa.
To 2: The technique of transnasal sinus surgery is based on endoscopical control, on refined instruments, and on the intimate knowledge of the surgical anatomy. For better visualization of the operative field one can use the microscope, which is convenient for meticulous dissection, but also has some disadvantages. I prefer a surgical endoscope, which allows the optical exposure of remote regions and a "glance around the corner". A new suction-irrigation-endoscope was devised, recently, which has proved very successfully for controlled manoeuvres in the maxillary sinus, in the ethmoidal regions, and for the visualization of the frontal sinus from below. Different angle optics can be attached to the shaft, which can be turned around its axis for 360° (Figure 3).
A set of special instruments serves for the manipulations under endoscopical control, including angled forcepses and punches. The use of both an air driven chisel and burr is emphasized, and the bipolar coagulation pincers is recommended for hemostasis within the nose.

SURGICAL ANATOMY

Two cross sections shall demonstrate the surgical anatomy of the ethmoid. The attention is drawn to a few points of particular interest. The supraorbital formation of ethmoid cells may be very prominent (Figure 4). The fronto-nasal duct, on the other hand, may be very narrow at its ethmoidal orifice, its direction being curved superio-anteriorly, so that the exposure of the frontal sinus from below sometimes requires extensive bone work with the diamond burr.

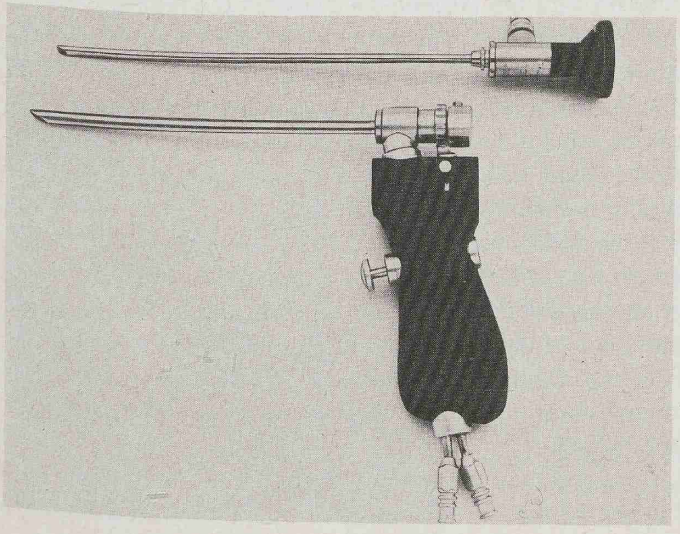


Figure 3.
A new suction-irrigation endoscope with exchangeable optics of between zero and 110 degrees. Its shaft can be turned around its axis for 360 degrees. The front objective is kept clean by the saline irrigation, triggered by a push-button, and by continuous suction at the tip of the instrument.
(R. Wolf, Knittlingen)

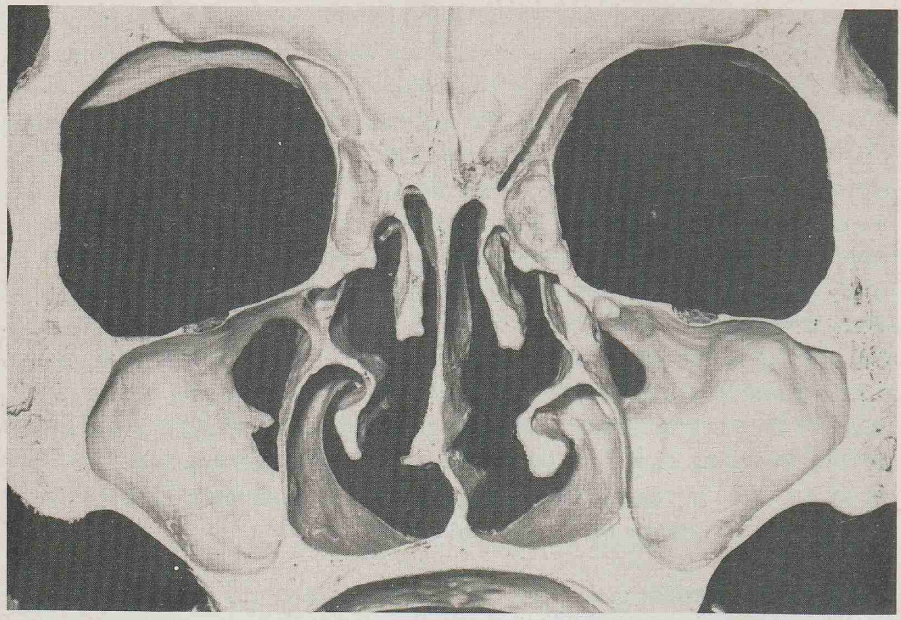


Figure 4. Coronal section through a skull specimen. In its anterior portions the middle turbinate is anchored at the ethmoidal roof. A medial lamina can be preserved with ethmoidectomy.

A short comment on the olfactory rim has to be made: Small branches of the Fila olfactoria extend into the mucosa of the middle and upper turbinates as of the septum. Meticulous removal of polyps may tear off this mucosa and, therefore, open up a communication with the arachnoidal space. Postoperative cerebrospinal-fluid fistulas are, in my opinion, due rather to this fact than to undesired penetration of the cribriform plate by a forceps. If this happens, and the flow of csf can be visualized either by the microscope or the endoscope, immediate closure of the fistula is necessary, what is easily accomplished by gluing a free graft of conchal mucosa over the fistula with fibrin tissue adhesive. This happened six times in my material of more than 300 interventions.

The pneumatization of the middle turbinate should be mentioned: While in its anterior part a medial lamina can be followed to the roof of the ethmoid (Figure 4), its dorsal parts are anchored within ethmoidal cells (Figure 5). In cases of advanced polyposis these parts of the middle turbinate are filled with polyps and chronically infected mucosa. Therefore, the middle turbinate has to be removed almost completely in cases of severe, diffuse polyposis, what can be diagnosed by preoperative X-ray tomograms.

A typical transnasal ethmoidectomy will confront the surgeon with considerable bleeding from the mucosal wounds, in most instances. Controlled arterial hypo-

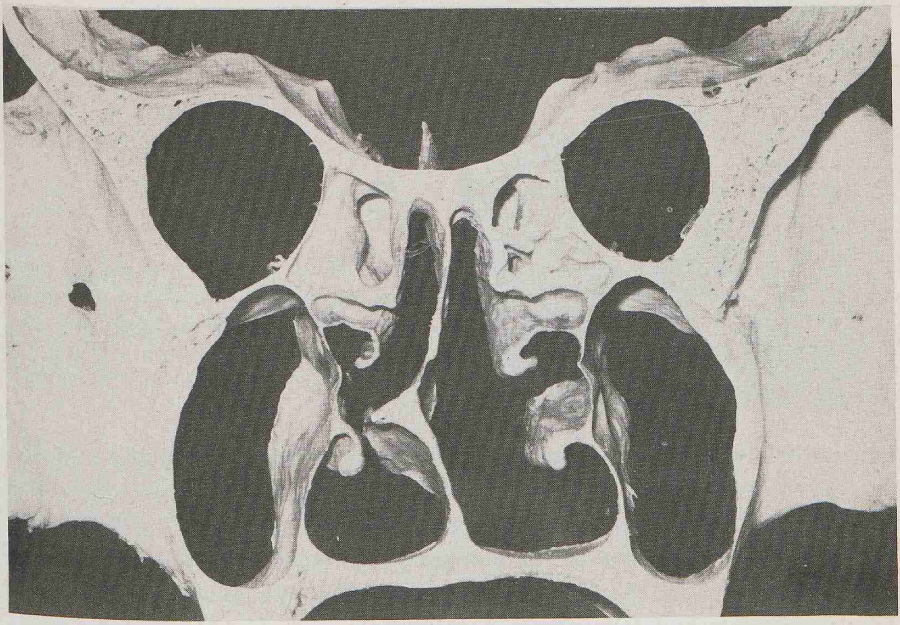


Fig. 5 Coronal section through a skull specimen. In its posterior portions the middle turbinate is covered by ethmoidal cells. Their complete removal will destroy the medial lamina of the middle turbinate.

tension is, therefore, provided, if possible. The operation consists of the following subsequent steps:

At first, the posterior ethmoidal cells are opened. Then the forceps of Blakesley enters the sphenoid cavity, the anterior wall of which is punched down, in order to expose the sphenoid cavity completely (Figure 6), and to avoid congestion of secretions.

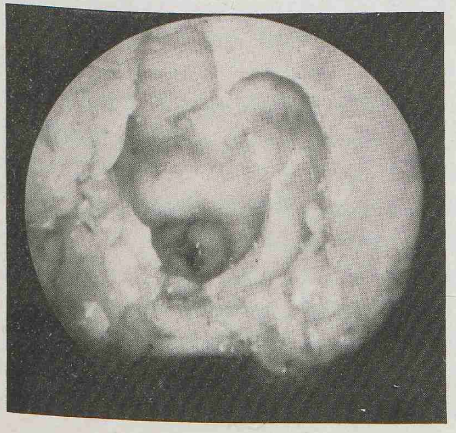


Figure 6. Endoscopical exposure of the sphenoid sinus. Its anterior wall is punched down for broad communication with nasal cavity (cadaver specimen).

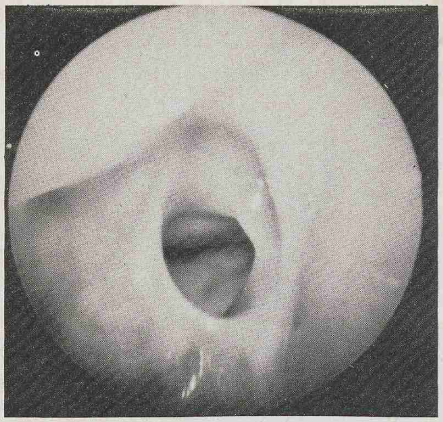


Figure 7. Frontal infundibulotomy. Endoscopical view into the frontal sinus from below, one year after the operation. The naso-frontal duct was drilled partly with a diamond burr. It is lined by a thin, healthy mucosa.

From here, where the spheno-palatine artery is a landmark, and can be coagulated as the main bleeder, I proceed anteriorly along the ethmoidal roof to the agger nasi, which is taken down with punch or diamond drill, by which manoeuvre the anterior ethmoidal cells are broadly exposed. Care is taken also to remove the lateral tract of cells, adjacent to the orbital wall, as well as cells within the nasal septum, and to fenestrate the middle nasal meatus, in order to establish a broad communication between the maxillary sinus and the ethmoidal bay.
The use of fibrin seal enhances the reconstruction of the olfactory rim by fixing the preserved olfactory mucosa of the upper turbinates high up to the ethmoidal roof.
Finally, we have to perform, what I call infundibulotomy: Using a diamond burr, the nasofrontal duct is opened up so far into the infundibulum, that inspection of the frontal sinus becomes possible (Figure 7), and its adequate drainage appears to be guaranteed. If manipulations within the frontal sinus become necessary, however, a separate small opening from outside has to be performed, similar to an enlarged Beck's puncture, allowing endoscopical treatment. Radical frontal sinus operations can be avoided in the majority of the cases with polyposis nasi et sinuum.
At the end of the operation there is a broadly open ethmoid bay, communicating with the nasal cavity, with the sphenoid and frontal sinuses, and opens into the maxillary sinus above the inferior concha (Figure 8).
The intervention is finished by gentle packing of the nose, for two days, including polyethylene tubes for nasal respiration through the packing.
Postoperative local treatment will be necessary for two to three months. It is supplemented by the eventual application of antibiotics and corticoids. During the first weeks after the operation careful aspiration of blood clots and crusts is of utmost importance. The crusts consist of dried secretions, and should not be confounded with the occurence of ozaena. Below the crusts there are remnants of

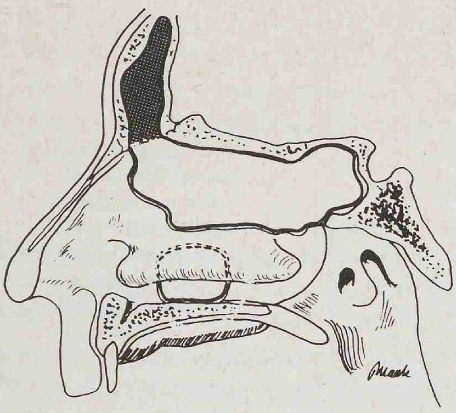


Figure 8. Schematic drawing of the ethmoidal bay after endonasal total ethmoidectomy. There is a broad communication with the frontal, sphenoidal and maxillary sinuses as with the nasal cavity. There is free communication with Highmore's cavity by fenestration of the lateral nasal wall in both the inferior and middle nasal meatuses. (Drawing by Gerhard Maak, M.D.)

mucosa or granulations. Proliferating granulation polyps or edematous flaps of mucosa should be treated punctually by etching with argentum nitricum or something like that. After some weeks a complete mucosal lining of the ethmoidal compartment will be reestablished. In our series of more than 300 ethmoidectomies there was no real case of postoperative ozaena.

Table 1. Results of ethmoidectomy.

Authors	Symptom free	Improved	Recurrence
Uffenorde	64%	20	10%
Eckel	60%	30%	10%
Dixon (1959)	75%	--	25%
Davison	74%	--	26%
own results	83%	6%	11%

RESULTS

The results of our transnasal ethmoidectomies are given by some figures in the Table 1. Out of a series of 84 patients, who underwent transnasal, bilateral total ethmoidectomy for severe, diffuse polyposis, and could be controlled for more than one year after the operation, 83% were successful with regard to the relief of symptoms and to cancellation of the use of corticoids. 6% showed a significant improvement, they felt better, but some minor rhinorrhea remained. 10% continued to suffer from their symptoms, and less than one percent uttered deterioration of their rhino-sinusitis after surgical treatment. In 10% nasal endoscopy reveiled recurrence of polyps, and a revision operation was planned. Three patients complained of postoperative anosmia, but 23 of 32 patients with preoperative anosmia, that is 72%, were rehabilitated with regard to olfactory function.

On the other hand, it has to be stressed, that there were no fatal complications in this series, no meningitis, no orbital complication nor loss of vision. Only in six cases out of the total of 300 cases, a transitory leakage of csf was discovered during

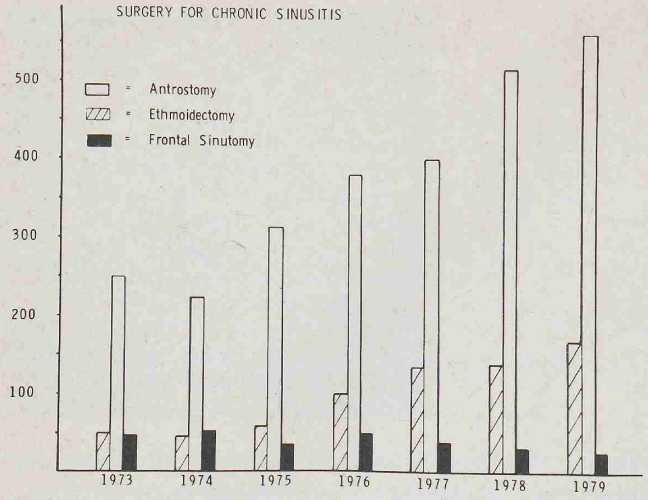


Figure 9. Incidence of surgical interventions for chronic sinusitis at the Department of Oto-Rhino-Laryngology of the university of Erlangen-Nuremberg. Transnasal antrostomy was started in 1975, transnasal ethmoidectomy for severe polyposis in 1976.

the operation, and was stopped in all cases by immediate closure using mucosal grafts and fibrin seal.

CONCLUSIONS

Since 1976 more than 300 transnasal ethmoidectomies for severe polyposis have been performed by the author. The yearly incidence of cases to be treated is given by Figure 9. The very favourable results, just shown, have encouraged us, to follow the described concept of rehabilitation of the mucosa. For limited involvement of the ethmoid, partial resection of the ethmoid cells can be performed correspondingly.

The rate of complications and of undesired side-effects in transnasal ethmoidectomy is very low in comparison to the classical transfacial radical ethmoidectomy. The absence of ozaena, induced by the operation, and inspite of the removal of the middle turbinate, has to be emphasized. In consequence, we are able to extend the indications of this endoscopical surgery to all forms of severe ethmoiditis, including severe polyposis, bronchial asthma, and even mucoviscidosis in children.

The preconditions of this kind of bio-mechanical approach to the problems of chronic sinusitis can be listed as follows:

1. A thorough knowledge of the very complicated topographical anatomy of the frontal skull base.
2. Improved techniques, taking advantage of special instruments and of the optically enhanced visualization of the surgical field, e.g. by the use of a suction-irrigation-endoscope.
3. A concept of treatment, oriented at the pathophysiology of the disease, inclu-

ding flanking therapy for better ventilation and drainage of the sinuses, and a consequent postoperative care of the patient, also reconsidering immunological factors, and, last, not least:

4. The devotion to meticulous microsurgery, and a long-range interest in the disabled patient.

ZUSAMMENFASSUNG

Die endonasale Chirurgie der Nasennebenhöhlen strebt die Erhaltung einer auskleidenden Mucosa in den reventilierten und gut drainierten Hohlräumen an. Sie kann sich auf eine Abtragung von knöchernen Engstellen an Fenstern und Ausführungsgängen beschränken ("Isthmus-Chirurgie"). Die transnasale Ethmoidektomie zur Behandlung der diffusen Polyposis schafft durch Beseitigung der Zellsepten ein übersichtliches, schleimhautbedecktes Siebbeinfach. Oft ist zur Freilegung aller erkrankten Regionen die weitgehende Opferung der mittleren Muschel notwendig sowie die breite Fensterung der Keilbeinhöhle und der Stirnhöhle von unten. Unter Berücksichtigung einer konsequenten Nachbehandlung sowie immunologischer und allergischer Mitursachen liefert die transnasale Ethmoidektomie gute klinische Resultate. Ein neues Saug-Spül-Endoskop und verbesserte Greifinstrumente tragen erheblich zur operativen Übersicht und zur Vermeidung von Komplikationen bei.

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