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Nasal antrostomy

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SUMMARY

With chronic maxillary sinusitis the pathological changes in the diseased mucosa used to be considered irreversible, thus necessitating its radical removal, which is only possible with the Caldwell-Luc operation. The discovery of the reversibility of the pathology caused a shift from the Caldwell-Luc towards endonasal procedures, of which the inferior meatal antrostomy became the most widely used. Nasendoscopy, later combined with computed tomography, led to the development of the concept of the osteomeatal unit, and hence the functional endoscopic sinus surgery, which is concentrated round the infundibulum region.

In view of possible risks and complications of that method it is propagated here to differentiate between these two techniques:

When the focus of chronic sinusitis appears to be situated in the infundibulum/anterior ethmoid region, the functional endoscopic surgery seems preferable;

For cases where the inflammatory process was restricted largely to the maxillary sinus a modified inferior meatal antrostomy technique proved to have a 92% success rate in 378 sinuses.

Sinusitis is the clinical diagnosis of a bacterial infection of the paranasal sinuses, which acts as a focus of its own, as a result of a bacterial superinfection of a viral rhinitis/rhinopharyngitis.

This bacterial superinfection results from colonisation of the nose and paranasal sinuses by potentially pathogenic bacteria which belong to the residential flora in the pharynx of the patient. It is a common disease in otorhinolaryngological practice. Even before antibiotics became available it was generally accepted that acute sinusitis could normally be cured by conservative measures (Fürstenberg, 1938).

The surgical treatment of chronic or recurrent paranasal sinusitis, however, has been a subject of controversy both before and after the development of antibiotics. Until recently the maxillary sinus was generally considered to be by far the most commonly afflicted of all paranasal sinuses. The combination of systematic endoscopy of the nose with high-resolution computed tomographic imaging has caused even that conception to become open to discussion.

In the course of time four subsequent approaches have been described for the

surgical treatment of maxillary sinusitis: via the alveolar process, via the inferior meatus, via the canine fossa and via the middle meatus. The third method, via the canine fossa has won a permanent place in otorhinolaryngology as the operation described by Caldwell (1893)-Luc (1897). Besides making a large antrostomy towards the inferior nasal meatus, its principal aim was a radical removal of all the mucosal lining of the sinus, since most pathological changes in the mucosa were considered to be irreversible. The fact that only the canine fossa approach offers an access towards the maxillary sinus, sufficiently wide to remove the complete mucoperiosteum, is probably the reason why the Caldwell-Luc operation became so popular. The possibility to perform a relatively safe ethmoidectomy in combination with this operation via the same approach has certainly contributed to its wide-spread application.

Before antibiotics became available it certainly was often necessary to remove most of the diseased mucous membrane from the maxillary sinus in order to cure the infective process. Thus Semenov (1938) considered any mucosal thickening over 2 mm to be irreversibly pathologic. Macbeth and Bernstein in 1968 and 1971 respectively still advocated the radical procedure in chronic sinusitis, regardless of the appearance of the mucous membrane. Macbeth claimed an 88% overall satisfactory result in 360 Caldwell-Luc-operations, but the vast majority of patients were never seen after one to three months. Besides, of this satisfactory group 30% had minor trouble postoperatively, meaning continuing symptomatology or the need of occasional polypectomy.

Postoperative morbidity after Caldwell-Luc is seen in an average of 30% (Legler, 1980), and can be roughly divided into two groups:

a. Complaints due to scar tissue.
   The classical Caldwell-Luc as a rule does not in practice achieve a total removal of the thickened mucoperiost. Scar tissue, formed in the denuded cavity often leads to partial obliteration of the lumen and webs, separating parts of the lumen. Isles of left-behind mucosa may develop into ill-drained pockets or even cysts and pyoceles, causing chronic irritation.

b. Damage to the infraorbital and superior alveolar nerves.
   Many authors (e.g. Martensson, 1950; Feldmann, 1978) have described the risks of damage to these nerves. Discussing the possible ways to avoid lesions to (branches of) the alveolar nerves Brusis (1979) advised to make the fossa canina entrance only medially. Alusi (1980), on the contrary warned to do so only laterally, whereas Harrison (1971) considered it to be a normal consequence of the Caldwell-Luc that the patient suffered hypaesthesia in one or two teeth. In children, furthermore, the operation can hardly be carried out at all, as the tooth buds of the permanent teeth are in the way.

Endonasal approaches towards the maxillary sinus

Both endonasal approaches for surgical therapy of maxillary sinusitis, via the inferior and middle meatus respectively, do not have the complications mentioned above. On the other hand, complete removal of the mucosal lining from the maxillary sinus is obviously impossible via this way.

Until recently the older of these two, the inferior meatus antrostomy was by far the most widely used alternative for the Caldwell-Luc. It was first mentioned by Mikulicz in 1886, and largely propagated by Claoué in 1912 (In fact, in The Netherlands a modification after the latter is still being called Claoué-operation). In 1934 Goodyear thought that healing after inferior meatus antrostomy was more complete than after Caldwell-Luc, as he found less residual mucosal thickening. Buckley (1934) had good overall results, but found that in several cases additional procedures had to be carried out, such as polypectomy, to obtain a complete cure. Williams (1935) preferred the inferior meatal antrostomy to the Caldwell-Luc as it had equally good results (80%) without the possibility of postoperative neuralgia. In 1939 Hempstead even claimed a 97,5 % success rate in cases of unilateral maxillary sinusitis. In the more recent literature the restoration of ventilation of the maxillary is considered to be the most important effect of the inferior meatal antrostomy, contrary to the earlier publications in which drainage through gravity was the main goal. Recent publications (Dixon, 1976; Mann, 1978; Wigand et al., 1978; Wigand, 1981; Buiter, 1982; Lund, 1985) regard the restoration of ventilation a vital factor in the healing process, and mention that even severe mucosal disease, which in the past had often been considered irreversible, usually undergoes resolution, thus enabling the mucociliary clearance to take place again via the normal way, i.e. towards the middle meatus. To obtain a permanent open antrostomy it was found that the initial size had to be larger than 1 x 1 cm (Lund) and that only those parts of the diseased mucosa, larger polyps and cysts, which might impair aeration needed to be removed (Wigand, Buiter), to which endoscopy proved an indispensable aid (Wigand).

The middle meatal antrostomy was already mentioned as early as in 1899 by Siebenmann, who professed to be able to perforate the lateral wall of the middle meatus with his little finger, and even to palpate and judge the antral mucosal lining with it. Onodi (1903) and Kubo (1912) developed special trocars to this purpose. At the time these were blind procedures, which gave rise to severe complications, e.g. perforations into the orbit, in the optic nerve. In order to avoid the possibilities of 'going too far' Lavelle and Harrison (1971) gave precise measures of the anatomy concerned, performing middle meatal antrostomies in the posterior fontanelle.

Accurate operations in the middle meatus, however, are possible only under adequate visual control. Moreover a detailed knowledge of the anatomy is essential. Nowadays nasendoscopy can fulfill these two conditions.

Endoscopy: development

In 1909 Zaufal declared that he had been the first to introduce an endoscope into the nose as early as 1880. He mainly studied the orifice of the auditory tube into the nasopharynx with it. Hirschmann appears to have been the first to perform nasendoscopy and antroscopy (endoscopy of the maxillary sinus) in 1901. The coloured plates drawn after the endoscopic pictures, which he included with his publications, prove that he had a quite usable optics already. After Hirschmann a silence fell round nasendoscopy. A long series of publications on antroscopy followed Hirschmann's, however, among which those of Spielberg (1922), Maltz (1925), Christensen (1946), Timm (1956), Bauer and Wodak (1959), Rosemann (1961), Illum and Jeppesen (1972), Hellmich and Herberhold (1972); Buiter (1974, 1975).

Messerklinger (1970, 1972, 1972, 1972) resumed the work of Hirschmann, and developed nasendoscopy into the full-grown method of examination which seems so indispensable now. Widespread use of the possibilities of endoscopy of the upper airways was not made until the first systematic works on this subject had appeared (Buiter, 1976; Draf, 1978; Messerklinger, 1978; Terrier, 1978).

The concept of the osteomeatal complex

In addition to developing nasendoscopy as a routine method of examination, Messerklinger (1966, 1967) studied the pathways of mucociliary clearance in the nose and paranasal sinuses both in patients and in fresh autopsy specimens. He noted that a local disruption of the mucociliary clearance occurred when two mucosal layers came into contact. Thus retention of secretions took place in such areas even in the absence of closure of ostia. Twenty years of such examinations, combined with pluridirectional tomography enabled Messerklinger to identify ventilatory and clearance defects in the middle meatus and anterior and middle ethmoid cells. In these areas, due to the narrow anatomy, especially when one or more of the frequent anatomical variations are present, the mechanism mentioned above easily occurs, causing both persistent local inflammation and hence impaired drainage of the frontal and maxillary sinuses, which are dependent on this area. The most vital part of this osteomeatal complex is the infundibulum, situated between the anterior part of the middle concha, the uncinate process and the ethmoid bulla, which might be called the key-area in the drainage and ventilation of the anterior paranasal sinus complex, therefore.

Apart from the anatomical aspect there is an other reason why this area might have an impaired colonisation resistance: Proctor, in 1966 and Wolfsdorf et al. in 1969 demonstrated in aerodynamic experiments that it is probably the anterior end of the middle concha which undergoes the greatest impact of the inspiratory airflow. The fact that there often is metaplasia of the mucosa covering the head of the middle concha is probably due to this phenomenon. Further evidence that

this region is the primary site of intense contact with airborne irritants is given by studies describing it as the predilection site for the development of adenocarcinoma in woodworkers, as mentioned by Hadfield (1970) and squamous cell carcinoma in workers exposed to nickel fumes (Torjussen et al., 1979). Also the fact that lupus nasi, when present, is primarily found in the head of the middle concha and the agger nasi region, points in the same direction. Thus the conclusion seems justified that this area suffers constant irritation which can easily provoke an inflammatory reaction in the mucosa. The accompanying edema will cause an impaired ventilation and drainage in the narrow passages of the osteomeatal complex, thus giving rise to a localised chronic inflammatory disease, which then can act as a focus for the development of more extensive pathology.

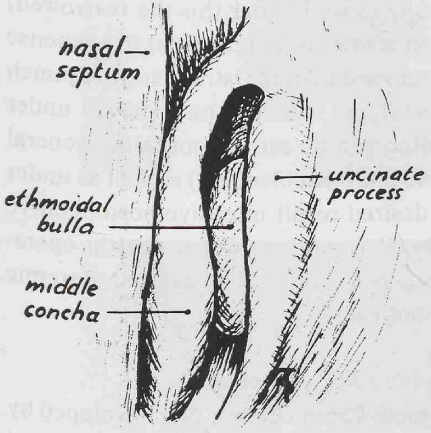

Figure 1.a.

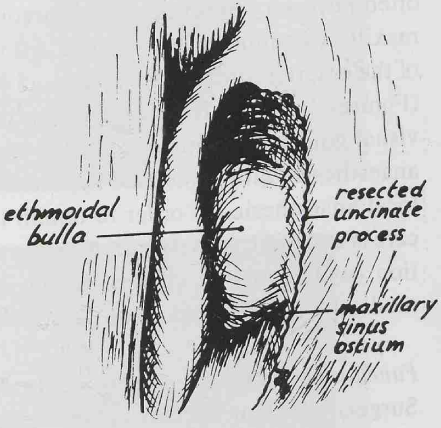

Figure 1.b.

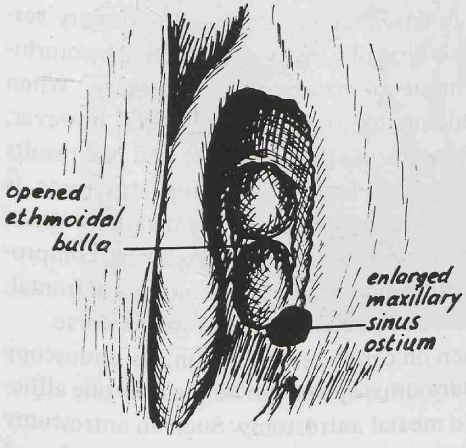

Figure 1.c.

Figure 1.a, b, c.
Three steps in functional endoscopic surgery.
- middle meatal antrostomy.

The most accurate diagnosis of any pathological changes can be made when nasendoscopy is combined with computed tomography. Computed tomography can reveal mucosal changes and anatomical relations, lying deeper than the areas which are visible endoscopically, which might at best result in only gross opacification on routine sinus roentgenograms. On the basis of an accurate diagnosis thus obtained it is possible to perform a precise and detailed surgery which should consist of taking away only those structures that compromise sufficient ventilation and drainage: functional endoscopic surgery.

Functional endoscopic surgery

In order to obtain access to the infundibulum it is always necessary to remove the uncinate process. For a proper ventilation and drainage of the maxillary sinus it is often necessary to remove the ethmoid bulla as well. After this the (narrowed) maxillary ostium can be widened, for instance inferior-anteriorly at the expense of the anterior fontanelle with the aid of backward cutting Ostrum antrum punch (Figures 1a, b, c). If necessary, diseased ethmoid cells can be removed under visual guidance (Figures 2, 3). The operation can be carried out under general anaesthesia (with controlled hypotension to diminish bleeding) as well as under local anaesthesia. In order to obtain the desired result intensive postoperative care is essential; to avoid adhesions or renewed ostomeatal obstruction the operation cavity must be cleaned under endoscopic control. Topical and systemic medical treatment has to be given when indicated.

Functional endoscopic surgery vs. Antrostomy: what to choose when?

Surgery following the concept of the osteomeatal complex was first developed by Messerklinger (1985) into an endoscopic procedure, performed under local anaesthesia. His technique was further propagated by Stammberger (1985, 1986) and Kennedy (1985). The concept of functional endoscopic sinus surgery certainly has great advantages, as long as this kind of surgery is performed by otorhinolaryngologists, skilled in the technique of nasendoscopic surgery. When attempts are made by surgeons not adequately trained in this field, however, there is an increased risk of complications during the procedure and bad results afterwards. If surgery of the infundibulum and surrounding structures is performed for an inflammatory process restricted largely to the maxillary sinus, and the result is an obstruction of the area due to adhesions and scarring, compromizing the ventilation and mucociliary clearance of the whole complex of frontal, anterior ethmoid and maxillary sinuses, the patient has been made worse.
Therefore it would seem advisable when on careful examination, i.e. endoscopy and computed tomography, the maxillary sinus appears to be the only one afflicted, to perform a really isolated middle meatal antrostomy. Such an antrostomy could be made as indicated by Straatman and Buiter (1981) or Friedrich and

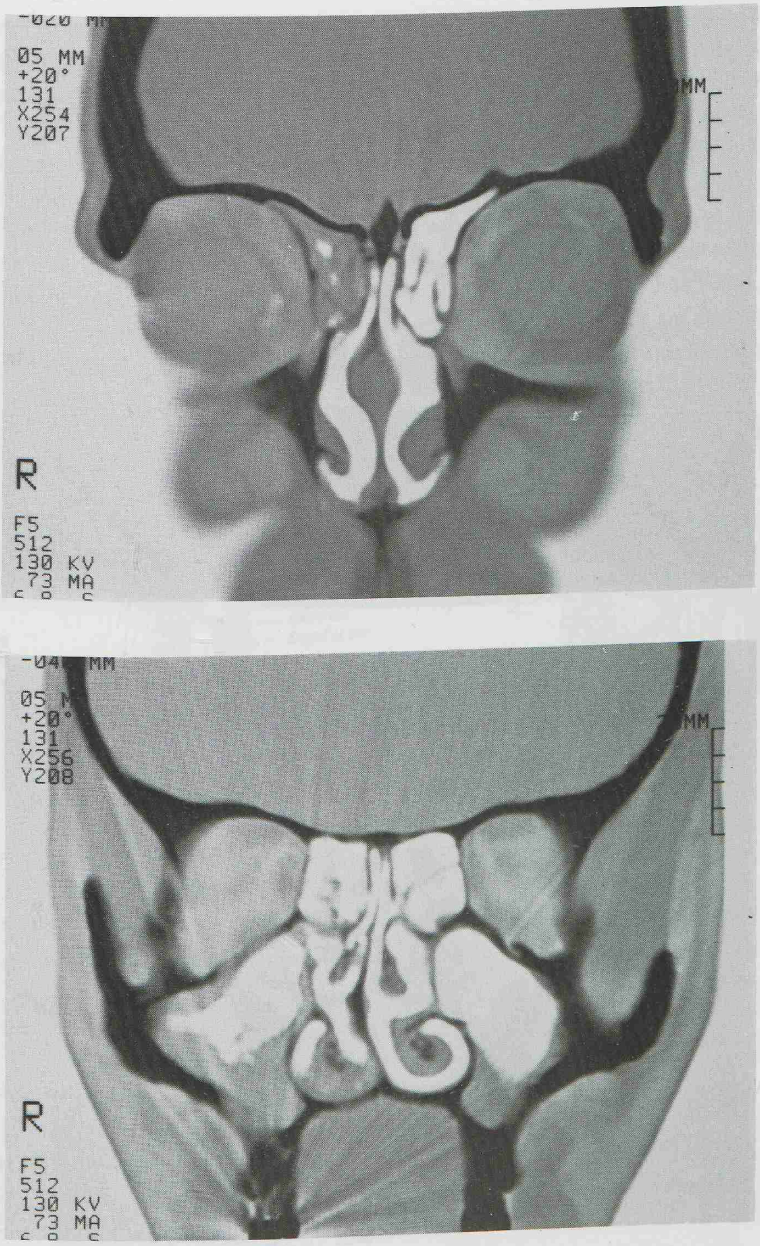

Figure 2. Bilateral maxillary sinusitis and rightsided anterior ethmoiditis.

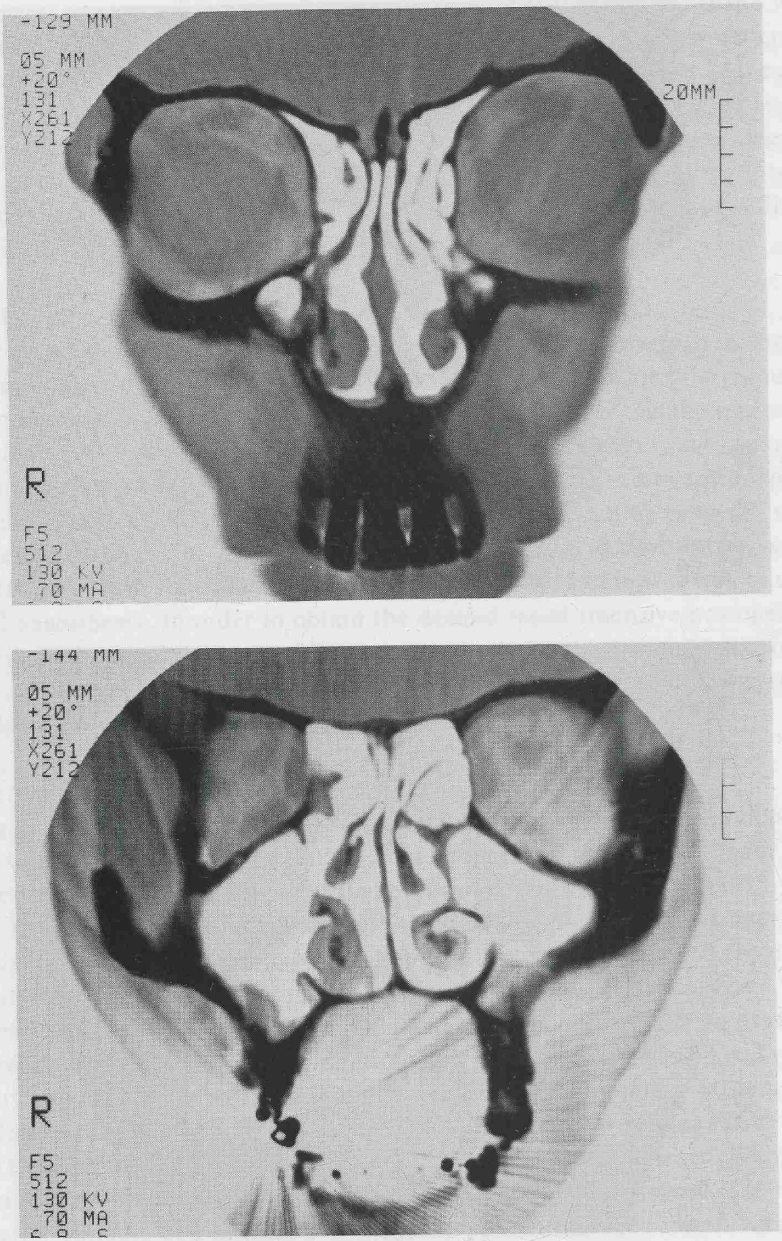

Figure 3. Complete healing of sinusitis (cf. fig. 2) after bilateral inferior meatal antrostomy and rightsided functional endoscopic infundibulum surgery.

Terrier (1984), who avoid surgery of the osteameatal complex in these cases. Signs of minor irritations or inflammation in the region of the osteomeatal complex could well be regarded as secondary to the maxillary sinusitis in these cases, in our opinion. The mucopurulent secretions from such an 'isolated' maxillary sinusitis pass these regions on its way towards the nose, and the toxines in these secretions are bound to give rise to inflammatory reactions there.
In cases where the inflammatory complex is mainly confined to the maxillary sinus we still prefer what we regard as the safest method: the inferior antrostomy. If it fails completely the only result will be that no antrostomy has been performed. When the anterior third of the lateral wall of the inferior meatus is left intact and the pterygoid region is respected no complications or unwanted side-

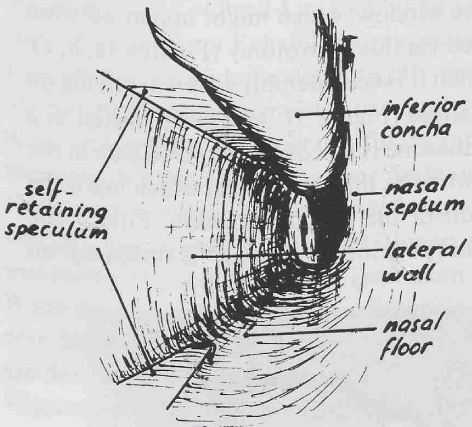

Figure 4.a.

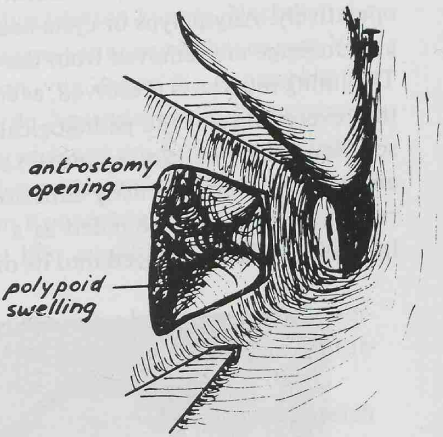

Figure 4.b.

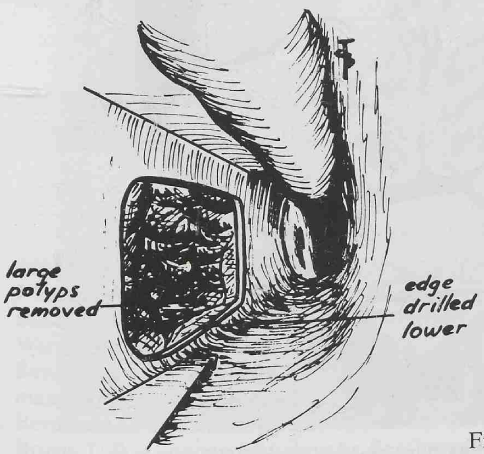

Figure 4.c.

Figure. 4.a, b, c. Three steps in modified inferior meatal antrostomy.

effects will occur. In a series of 378 consecutive cases operated upon after our technique, with a follow-up of at least one year we obtained a 92% success rate in these cases.

Inferior meatal antrostomy

In short our inferior meatal antrostomy technique consists of the following steps: Upward luxation of the inferior concha, in which position it is kept with the aid of a self-retaining speculum. Electrosurgical circumcision of a mucosal flap of 2½ x 1¼ cm, with its base at the level of the floor of the nose. Removal of the flap. Creation of a naso-antral window in the bony wall with the aid of specially modified chisels. The base of this window is drilled with a semi-cutting cylindrical burr at such a low level that a smooth entrance of a rinsing canula will be possible postoperatively. Any polyps or cysts near the window, which might impair aeration and drainage are removed from the sinus via this antrostomy (Figures 4a, b, c). The lining mucosa is preserved, even when it is considerably swollen, relying on the reversability of the pathological changes (Figure 5). A gelita®, soaked in a solution of xylometazoline and dexamethasone is placed on the nasal side in the antrostomy to prevent early adhesions with the inferior concha which has to be regarded as slightly wounded as a result of the upward luxation. Finally the inferior concha is replaced into its original position. The gelita® is rinsed out on

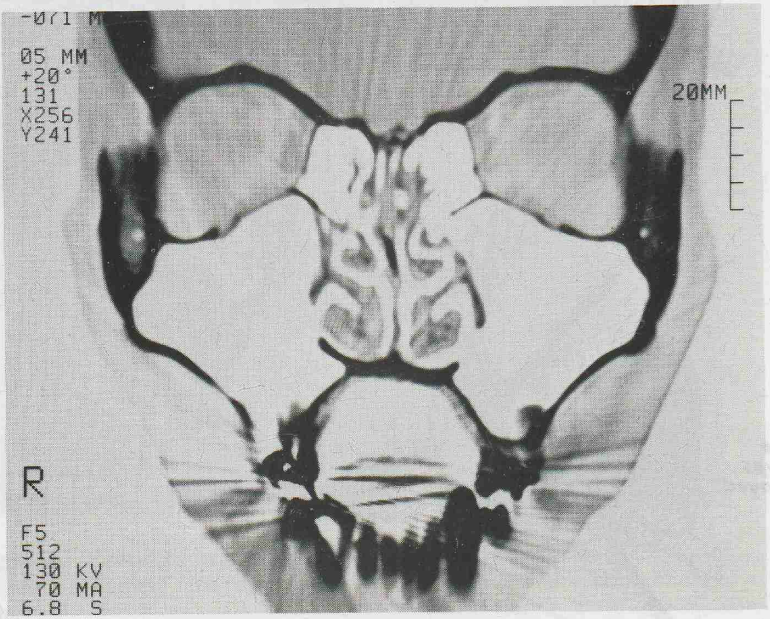

Figure 5. Perfectly healed maxillary sinuses after inferior meatal antrostomy.

the second postoperative day. The operation can be performed under general as well as under local anaesthesia.
Comparison of the many different techniques of surgical treatment of maxillary sinusitis will always be very difficult, as it is still valid what has been said by Benjamins and Huizinga in 1931 already: there are no reliable statistics on this subject. Every case has to be judged individually after careful examination, after which that technique has to be chosen which offers the desired result with the least possible surgery and has the fewest possible complications and side-effects.

ZUSAMMENFASSUNG

Die Voraussetzung dass die meisten Schleimhautveränderungen chronischer Sinusitis unumkehrbar wären hat veranlasst dass die radikale Schleimhautausraümung nach Caldwell-Luc sich langfristig durchsetzen konnte. Nachdem die grosse Kapazität zur Rehabilitierung allmählig anerkannt wurde hat es eine Verschiebung nach endonasaler Eingriffe gegeben, von denen die Fensterung im unteren Nasengang am meisten verwendet wurde. Nasendoskopie, später zusammen mit Computer Tomografie, führte zur Entwicklung des Konzepts der osteomeatalen Einheit, und daher zur funktionellen endoskopischen Chirurgie der Nasennebenhöhlen, die um das Infundibulum Konzentriert ist. Angesichts die Gefahre und mögliche Komplikationen wird hier empfohlen Unterschied zu machten zwischen diese zwei Techniken:
Wann der Fokus der chronischen Sinusitis offenbar in das Infundibulum/die vordere Siebbeinzellen lokalisiert ist soll der funktionellen endoskopischen Chirurgie den Vorzug gegeben werden;
Wann die Entzündung hauptsächlich auf die Kieferhöhle beschränkt ist, hat sich eine modifizierte Fensterungstechnik im unteren Nasengang 92% erfolgreich erwiesen in 378 Fälle.

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