Chapter 3: Endoscopy of the nose and sinuses

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The technique of examination of the nasal cavity and nasopharynx has remained essentially unchanged since the development of otolaryngology as a separate specialty during the nineteenth century. Routine anterior and posterior rhinoscopy, using a speculum, mirrors and light source, are still the standard techniques of inspection and assessment of the nasal airway. The views obtained by these methods are necessarily incomplete and are usually augmented by radiological examination of the nose and paranasal sinuses. The development of endoscopic techniques allows direct examination of these structures and has focused attention on the difficulties of accurate assessment in nasal and sinus disease. Simply stated, there are three major reasons why endoscopy is of vital importance if adequate information is to be obtained about the state of the nasal cavities and paranasal sinuses:

(1) certain parts of the nasal cavities are inaccessible to view without the use of endoscopic techniques, that is the superior, middle and the inferior meatus

(2) radiographic evidence of the degree and type of sinus pathology has now been shown to be highly suspect; at best there is only a 50-60% correlation between radiographic findings and the actual findings in the sinuses at endoscopy or surgery (Illum, Jeppesen and Langebaeck, 1972; Herberhold, 1973; Pfleiderer, Croft and Lloyd, 1986)

(3) examination of the postnasal space via mirror posterior rhinoscopy is impossible in about 20% of patients.

History of endoscopy

In 1853, D'Esormeux demonstrated an alcohol illuminated urethroscope, winning a prize at the Paris Exhibition of that year. Endoscopy was born. The development of electricity followed and, by 1879, Leiter had developed a distally illuminated, water-cooled cystoscope which created great interest. Nitze's success in using this instrument stimulated Zaufal to use a modified cystoscope to examine the eustachian tube orifice pernasally during the 1880s. However, the 'father' of nasal endoscopy was Hirschmann, who used a special endoscope only 4.0 mm in diameter to examine the middle meatus and study the sinus ostia at the turn of the century (Hirschmann, 1903). Hirschmann also examined the maxillary antrum, via a molar tooth socket, for diagnostic purposes, but had been preceded by Reichert in 1902 who published his observations on antroscopy and was the first to perform and describe minor intrasinus manipulations under endoscopic control (Reichert, 1902). However, the work done by these pioneers was not taken up, and perhaps the arrival of apparently adequate diagnostic radiology during the next decades pushed this new technique to one side. By 1925, nasal endoscopy was being described as 'an interesting amusement' and had been largely discarded.

During the 1950s, several developments improved the technology of endoscopy - Hopkins working at Imperial College developed his solid rod lens system and the proximal 'cold light' source. These important innovations allowed much better optical views using the
new telescopes and greatly extended their use. Subsequently, several workers on the Continent have reported on the beneficial results of sinus endoscopy in the diagnosis and treatment of chronic sinus disease. This work has been carried on enthusiastically during the last decade and has resulted in the excellent publications of Buiter (1976) and Draf (1983).

**Indications for endoscopy**

**Nasoendoscopy**

(1) To evaluate inaccessible areas in the nasal cavity, for example the *superior meatus* in cases of anosmia; the author has found patients with polyps and obstructing adhesions *above* the middle turbinate completely unseen on routine anterior rhinoscopy which required surgical lysis and which resulted in a return of the sense of smell.

The *middle meatus* - evaluation of sinus ostia and surroundings for obstructing pathology. This area can only be visualized with difficulty using routine anterior rhinoscopy.

The *inferior meatus* - usually to check on the status of previously created surgical antroscopies, are they patent or obstructed?

(2) To monitor the nasal fossa after resections for tumours, that is radical maxillectomy or more extensive craniofacial resections. It is impossible to examine the cavities of these patients adequately if the hard palate is intact.

(3) To evaluate epistaxis of unknown origin and the nasal fossa in cases of cerebrospinal fluid rhinorrhoea. The author has used endoscopy to help localize a difficult cerebrospinal fluid leak to the sphenoid sinus area.

(4) To assess the spread of paranasal sinus tumours within the nasal fossa, with respect to their superior and posterior extremities.

(5) To assess the degree and site of airway obstruction in the nasal cavity. Lesions obstructing the posterior choanae and nasal cavities can best be assessed endoscopically.

(6) To monitor progress in the treatment of nasal and paranasal sinus infections.

**Nasopharyngoscopy**

Hays (1909) described endoscopic examination of the nasopharynx through the mouth - and subsequently many workers have followed this route (Buiter, 1976). The author prefers to examine the nasopharynx pernasally using flexible fibreoptic instruments such as the Olympus ENF 'P'. (See the section on Technique.)

**Inaccessible nasopharynx**

To examine the nasopharynx in 15-20% of the population in whom it is inaccessible.
Examination of tumours of the nasopharynx

This technique allows precise documentation of the site and extent of the tumours of the nasopharynx. It is possible to obtain a biopsy under local anaesthesia on an outpatient basis - either by using a flexible fibrescope with a biopsy channel (Olympus ENF-LB) or by inserting a Barts' forceps through the opposite nasal fossa and obtaining a biopsy under direct visual control. This technique allows rather more precise biopsies than those obtained using a mirror and pernasal biopsy under general anaesthetic in the classical manner.

Post-treatment evaluation of the nasopharynx

The majority of patients with nasopharyngeal tumours will receive primary radiotherapy, although a minority, such as those with angiofibromata, will be treated surgically. The problems which arise following radiotherapy treatment are those of mucosa crusting and scarring, which can make indirect mirror examination and interpretation difficult. Direct pernasal examination is most helpful in these difficult cases in differentiating between recurrence and mere crusting with infection.

Functional studies

Examination of the eustachian tube orifice in cases of dysfunction is of paramount interest to the otolaryngologist. Is there benign or malignant obstructing pathology? Or evidence of inflammatory or allergic changes creating the problem? Direct biopsies can be taken which will help in planning treatment.

The major resurgence of interest in direct nasopharyngoscopy followed the work of Pigott (1969) who used this route to study patients with incompetence of the velopharyngeal sphincter, both before and after cleft palate repair. Nasopharyngoscopic monitoring of the velopharyngeal sphincter is now one of the standard methods of diagnosis and assessment at cleft palate clinics and has led to the documentation of microforms of cleft palate (Croft, Shprintzen and Daniller, 1978) which are of particular interest to otolaryngologists because of the dangers of rhinolalia aperta developing in these patients after adenoidectomy. It has also become apparent that there are various patterns of closure of the velopharyngeal sphincter (Croft, Shprintzen and Rakoff, 1981) and that the different components of palatal elevation, lateral pharyngeal and posterior pharyngeal wall motion vary considerably from individual to individual. It is also clear that the posterior wall motion of 'Passavants' ridge occurs in a percentage of normal subjects and is not merely a compensation seen in patients with velopharyngeal insufficiency (Croft, Shprintzen and Rakoff, 1981).

Airway evaluation

There is increasing evidence that airway obstruction in the nasal cavity or nasopharynx may be responsible for the development of snoring with or without sleep apnoea. Although this subject is covered elsewhere (see Chapter 17), the author regards flexible nasopharyngoscopy as mandatory in studying patients with sleep-related breathing problems. This manoeuvre allows documentation of both physical and functional airway obstruction and the reader is referred to the recent paper by Sher et al (1985) which discusses endoscopic examination in combination with the Müller manoeuvre to predict the response of patients to
upper airway surgery such as uvulopalatopharyngoplasty. This would appear to increase the success rate of this type of surgery in relieving obstructive sleep apnoea and snoring.

**Technique**

**Rigid nasoendoscopy**

The author favours the 30° angle viewing 4.00 mm Storz Hopkins rod for evaluation of the nasal fossa. Simple preparation of the nose requires adequate spraying with a solution of 2% lignocaine and 1:2000 adrenaline which allows excellent mucosal reduction and anaesthesia. The wider nasal cavity is then examined with the patient semi-recumbent and the head supported to prevent movement. The telescope is passed posteriorly above the inferior turbinate, below and medial to the middle turbinate. The nasal cavity is examined thoroughly with the middle meatus examined as the telescope passes to the posterior choana. Posteriorly the sphenoid recess is examined followed by evaluation of the region above the middle turbinate. Occasionally nasal anatomy may dictate the use of the inferior meatus to reach the nasopharynx and this area must be examined in patients who have previously undergone intranasal antrostomy or Caldwell-Luc procedures.

The *main contraindication* to rigid nasoendoscopy is deformity of the nasal septum which may preclude the use of rigid instrumentation - flexible fibreoptic endoscopy will then be required.

**Flexible nasoendoscopy and nasopharyngoscopy**

The author favours the Olympus ENF-P nasoendoscope which has a 2.9 mm diameter bundle and 90° tip deflection in both directions. Although this instrument is fragile and has no biopsy or suction channel, its uniquely small size allows pain free examination of the airway and it is possible to use it in neonates without difficulty. The ENF-LB has a larger 4.0 mm bundle and integral biopsy channel which is useful for clearing secretions and obtaining endoscopic biopsies. The use of either rigid or flexible instrument requires use of a demisting agent, such as 'Ultrastop' or simply using a little Savlon solution. Warming the rigid telescopes in warm water is perfectly satisfactory but, over the long term, may damage flexible fibreoptic instruments.

Local anaesthesia and mucosal reduction is obtained just as in rigid endoscopy using a 2%/1:2000 lignocaine/adrenaline spray. Occasionally patients require more than this rather simple application and packing the nose with a pledget of cottonwool soaked in the same solution is helpful. This is particularly so in children who may object to having their noses sprayed, but will tolerate a small cottonwool pad.

Flexible nasoendoscopy is performed with the patient sitting and the head supported. The examiner faces the patient and the endoscope tip is passed into the nasal cavity through the controlling fingers of the left hand which rest lightly on the patient's nose. The right hand controls the endoscopic body with the tip deflector control, allowing appropriate adjustments of the angulation of the endoscope within the nasal cavity. The widest part of the nasal cavity is examined first. This is usually the area between the middle and inferior turbinates. Flexible
endoscopes of the type described are very versatile and allow complete examination of the nasal cavity in nearly all cases.

**Sinus endoscopy**

**Uses and indications**

(1) Accurate diagnosis - resolving the dilemma of radiographic accuracy (*see below*): maxillary antrum, frontal sinus, sphenoid sinus.

(2) Suspicious symptoms with negative radiographs, unexplained pain or bleeding.

(3) Intrasinus surgery and monitoring the response to therapy.

(4) Early diagnosis of malignancy of the paranasal sinuses.

(5) Sinus involvement in pathology from surrounding sites.

**Method**

**Endoscopic instruments**

Rigid sinus endoscopy requires the use of rigid telescopes using Hopkins optics. The author uses Storz Hopkins rod telescopes with 0°, 30° and 70° angles of view. These solid rod lens telescopes provide excellent contrast and resolution with good depth of field. They allow good photographic documentation of intrasinus pathology.

**Photographic equipment**

(1) Storz photo flash generator - which combines a cold light source, flash and flash generator; the generator has variable settings for flash intensity.

(2) Single lens reflex camera (Olympus OM-1) with special endoscopic zoom lens and ring adaptor (Storz).

(3) High speed film - 400 ASA.

**Surgical instruments**

Maxillary or frontal sinus endoscopy requires the:

(1) Storz standard 16.5 cm trochar and cannula - the sphenoid sinus requires an extra long 20 cm trochar cannula, but with a similar diameter.

(2) Syringes and 12.0 F suction catheters for irrigation and aspiration of sinus content.

(3) Optical biopsy forceps - rigid integral biopsy forceps with an 0° miniature Storz Hopkins telescope.
(4) St Bartholomew’s ethmoid forceps - up and down biting for biopsies via the antrostomy

(5) Thudichum’s speculum and Hills elevator.

**Technique**

**Maxillary sinoscopy**

The nose is prepared by spraying with 1 mL of a solution of 2% topical lignocaine and 1:2000 adrenaline. This reduces problems with bleeding and mucosal reduction improves access to the favoured inferior meatal route. Under local anaesthesia, a strip of cotton wool soaked in lignocaine and adrenaline is packed into the inferior meatus.

Access is by way of (a) the inferior meatus or (b) the canine fossa. The author favours the inferior meatal route, believing it to be the simplest and therefore the safest of the two routes. The technique is very similar to that used for proof puncture and therefore already very familiar to otolaryngologists.

The 5.0 mm trochar and cannula is inserted under the highest point of the inferior turbinate and the bony wall pierced with a rotating movement of the trochar. It is important not to drive the trochar too far lest the lateral antral wall be traumatized and subsequent bleeding obscure the view of the antrum. The trochar is removed and, using telescopic control, the cannula is gently drawn backwards until the antral mucosa can be seen. This will provide a maximal view of the sinus interior. The antrum is then inspected using 70° and 30° telescopes. The telescopes have either been heated before use or the lens demisted using Ultrastop. It is important that inspection is performed by rotating the telescope and cannula around their axes and that no lateral leverage is used on either cannula or telescope as both bleeding and pain may result.

If bleeding has occurred and the field is obscured, then gentle suction via a No. 12 catheter or suction/irrigation with warm saline will clear the field fairly rapidly. Once a good view of the antrum is obtained, the condition of the mucosa and the extent of any abnormality is assessed. Free pus can be sampled for culture and sensitivities. Any mucosal abnormality can be definitely identified by biopsy and the site, number and patency of the sinus ostia assessed.

The canine fossa route certainly provides a more consistent view of the maxillary sinus ostium; it is approached following injection infiltration of the canine fossa mucosa with 2% lignocaine with 1:200,000 adrenaline. This procedure is best performed with the patient semi-recumbent. The highest part of the canine fossa is palpated and a small stab incision made using a No. 15 Parker knife blade. The trochar and cannula are then inserted using a rotating action into the antero-lateral wall of the antrum. Telescopic examination is then performed by way of the cannula as described.
Frontal sinoscopy

The main indications for endoscopic examination of the frontal sinus are unresolved radiographic abnormalities in symptomatic patients. This examination should be performed on a recumbent patient under general anaesthetic. Precise radiographic documentation of the lateral and anteroposterior dimensions of the frontal sinus is mandatory. The medial eyebrow is infiltrated with an injection of 2% lignocaine and 1:200,000 adrenaline. A 1.5 cm incision is made in the inferior margin of the eyebrow and the floor of the frontal sinus exposed. The periosteum is elevated and, using a drill with a cutting burr (6.0 mm), an inspection hole is made just below the orbital rim - the cannula and telescopes can then be inserted and pathology assessed and biopsies taken as required.

Sphenoid sinoscopy

The sphenoid sinus ostium can be visualized nasoendoscopically as already noted. It is quite possible to open the anterior wall of the sphenoid sinus near the midline under telescopic control, but the face of the sphenoid varies considerably in thickness and, rather than take risks in this vital area, the author prefers to approach the sphenoid via the midline trans-septal route using the operating microscope once the sphenoid rostrum is reached.

Discussion: sinoscopy versus radiology

A major problem which soon confronts the otolaryngologist engaged in sinus endoscopy is the discrepancy which is apparent between radiographic evidence and endoscopic findings.

Accurate diagnosis in cases of chronic sinus disease has always been difficult. It is certainly the case that poor preoperative diagnosis has contributed to many of the unsatisfactory results of sinus surgery and perhaps to its low popularity rating with patients. Efforts to improve diagnostic accuracy with antroscopy soon revealed the problem of poor correlation between X-ray changes and endoscopic findings. Illum, Jeppesen and Langebaeck (1972) and Herberhold (1973) showed only a 62% and 64% positive correlation in their comparative studies of sinus endoscopy and radiology. A recent study by the author (Pfleiderer, Croft and Lloyd, 1986) has confirmed the very poor correlation between what can be deduced from an X-ray plate and what is actually going on inside the maxillary antrum. The authors compared antroscopic and radiographic findings in 115 patients, examining 193 antra. The comparison was effected by correlating endoscopic and radiographic changes as shown in Table 3.1. Thus an ‘allergic’ mucosa was identified as pale and polypoidal at endoscopy and correlated with an irregular outline of the thickened mucosa seen radiographically. This study found that the radiological and antroscopic diagnosis was identical in 85 out of 193 cases studies, a positive correlation of 44%. However, current radiological techniques produced false positive and false negative findings of 35% and 9%, respectively. Radiographic techniques were particularly poor in identifying inflammatory disease, identifying an infected antrum in only 26% of cases in which the definitive diagnosis was made antroscopically. Furthermore, the antroscopic findings in 29 opaque antra showed that the majority were due to severe mucosal thickening, while a minority were infected and contained pus. Clearly, proper surgical planning in cases of sinus disease requires more objective information than that provided by X-rays and the return from a sinus irrigation.
Table 3.1 Radiological and antroscopic classification of mucosal changes in the maxillary antrum

<table>
<thead>
<tr>
<th>Radiographic</th>
<th>Antroscopic</th>
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<tbody>
<tr>
<td>I Clear</td>
<td>I Normal</td>
</tr>
<tr>
<td>II Cyst-like lesion</td>
<td>II Solitary cyst</td>
</tr>
<tr>
<td>III 'Polypoid' mucosal thickening*</td>
<td>III Allergic mucosal change</td>
</tr>
<tr>
<td>IV 'Straight' mucosal thickening&amp;</td>
<td>IV Infective mucosal change</td>
</tr>
<tr>
<td>V Opaque antrum</td>
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* Interpreted as being of allergic origin
& Interpreted as being of infective origin.

In this respect, it is a salutory lesson to inspect the maxillary antrum endoscopically after an apparently adequate sinus wash-out. The antrum may still contain large amounts of purulent material in spite of a clear return from sinus irrigation - certainly antroscopic control of irrigation of a grossly infected antrum is most useful.

Possible reasons for the diagnostic inaccuracy and discrepancies of sinus radiography may include:

1. A narrow lateral recess - the lateral recess contains less air than the main sinus cavity and superimposed bony shadows may create an appearance indistinguishable from mucosal thickening.

2. Basal region - radiographic variation due to differing bone density and contours at the base of the antrum can give rise to false positive and false negative information about the state of the mucosa at the sinus base.

3. Radiographs of maxillary antra which have been the site of previous sinus surgery are notoriously difficult to interpret. Endoscopic evaluation is mandatory to assess the status of the antrum in any meaningful way following surgery.

4. Faults in radiographic technique - cysts in the anterior portion of the antrum or mucosal thickening in the anteroinferior area of the antrum may show up as an opaque antrum in an overtilted occipitomental view.

**Management of chronic mucosal disease**

The ability to examine the sinus interior and contents and to directly biopsy and examine diseased mucosa presents a distinct advantage in the management of chronic sinus disease. In the presence of infected mucosa, repeated endoscopy can monitor recovery and the response to appropriate medical therapy. Return of the mucosa and vessel pattern to normal with identification of the natural sinus ostium are encouraging signs. Lack of response may suggest that a more radical approach would be justified.
The intrasinus control of simple pathology such as cysts and polyps is greatly facilitated by the use of endoscopic surgery as described. These approaches via the inferior meatus have greatly reduced the number of Caldwell-Luc procedures performed in the author's patients and reduced the number of patients requiring inpatient care and surgery. The socioeconomic effects of these treatment policies are obviously beneficial to all concerned.

**Diagnosis of sinus malignancy**

Antroscopy provides an opportunity to diagnose malignant disease of the upper jaw at an earlier stage than hitherto. The poor and unchanging survival figures for malignant disease of the paranasal sinuses (with five-year survival of around 35%) have not altered much over the last 25 years. Antroscopy does provide the opportunity to diagnose malignancies before they have spread beyond the bony confines of the sinus and while they have a much greater potential for cure. During the recent study of 190 antroscopies (Pfleiderer, Croft and Lloyd, 1986), one case of antral malignancy was discovered.

A further advantage of sinus endoscopy is the ability to fully assess the spread and involvement of tumours arising both in the paranasal sinuses and the nasal fossa. Radiographically opaque sinuses, in such cases, may be due to either direct tumour involvement or to obstruction of the natural ostium by tumour with retained and possibly infected secretions. Proper treatment planning demands precision in assessing the full extent of tumour involvement.

**Complications**

**Vasovagal collapse**

Endoscopic evaluation of the nose and paranasal sinuses under local anaesthesia may occasionally result in collapse. The author has had to deal with one respiratory arrest in several thousand endoscopies and during a recent series of 170 outpatient antroscopies two vasovagal collapses were experienced. Clearly it is important to have full resuscitation facilities available in any unit performing these procedures.

**Epistaxis**

This is usually minor and rarely requiring more than a temporary pack.

**Incomplete examination**

About 4% of endoscopies will be unsuccessful due to the anatomy of the sinus or septum and it may be necessary to adopt the canine fossa route. Bleeding may obscure the view and preclude a satisfactory examination. Management will require lavage and gentle suction to clear the sinus of retained blood.