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Atlas of Head and Neck Surgery

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Preface

Head and neck surgery is a rapidly developing surgical specialty. It is certainly unique, as over the years, surgeons have subspecialised in head and neck surgery coming from multiple surgical disciplines including (in alphabetical order) general surgery, oral and maxillofacial surgery, otorhinolaryngology and plastic surgery. Over the past few years, head and neck surgical fellowships have been created both nationally and internationally for surgeons of different surgical disciplines to be trained in this "subspecialty".

In many specialised tertiary centres, head and neck surgery represents a specialty of its own and can employ surgeons from all the feeding surgical core disciplines to work together.

The head and neck region is a complex and challenging anatomical area. Surgeons are treating pathology of 15 different anatomical subsites with multiple histopathological tumour types.

Head and neck surgery has significantly evolved over the last 20 years, and the turn of the century has seen significant improvements in all areas ranging from minimally invasive surgery including transoral laser and robotic surgery, and major ablative surgery with free flap reconstruction both in the primary and salvage setting. All these surgeries offer high success rates of cure with minimal complications in expert hands.

This textbook addresses the core procedures of this specialty in a manner that will help residents and young surgeons to understand the critical steps of each procedure and apply them into surgical practice in a safe and structured way.

We have chosen worldwide experts on each procedure, tried to combine expertise from different parts of the globe with the help of a Fellow to provide a balanced view of how these surgical procedures are carried out in a safe way.

We are confident that this textbook will serve its purpose to help not only young surgeons of around the world of the different specialties but also nurses and allied health professionals to understand the basic principles of head and neck surgical procedures.

Finally, we would like to thank Springer for having the trust, confidence and encouragement to see this project to fruition.

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Part I

Adult Endoscopy

1 Clinical Diagnostic Nasopharyngolaryngoscopy

Nicholas Gibbins and Hugo Galera-Ruiz

1.1 Introduction

History and examination will always remain the first line in the diagnosis and treatment of any head and neck pathology. Inspection and palpation must be followed by a thorough examination of the mucosal surfaces of the head and neck. For this, the flexible nasopharyngolaryngoscope is an essential piece of equipment for the head and neck surgeon.

Flexible nasopharyngolaryngoscopy (FN) of the head and neck has revolutionised otolaryngology and allows detailed examination of the naso-, oro-, and hypopharynx as well as the larynx in relative comfort for the patient and with a high degree of definition. A quick, accurate diagnosis helps guide the surgeon towards appropriate investigations and formulating an individualised treatment plan.

This chapter will also briefly discuss more recent extended uses of the endoscope that have become more commonplace, such as transnasal oesophagoscopy, using a channelled endoscope to perform in-office biopsies or treatments, or using alternate imaging modalities that have been more recently pioneered that may help with the diagnosis of mucosal lesions.

1.2 Equipment

To perform FN, it is necessary to have certain equipment, which includes the following material:

- Digital FN with chip-on tip technology of varying diameter sizes ranging from 1.9 mm for paediatric use to the 6 mm endoscopes equipped with a built-in working channel for passage of a flexible biopsy forceps or a laser fibre. Information from a chip in the distal tip of the endoscope is sent to a video processor, which creates a digital image and enables high-resolution imaging. The scope usually has some components that remain constant: the control with the up/down angulation system and different buttons (white balance, photo/video recording, etc.), flexible end section, the light cable, and the digital image cable which connects to the monitor/screen.
- Video processor system.
- High-resolution monitor/screen (4 K).
- Capture imaging system for photo/video documentation. An additional advantage of digital endoscopic techniques is the possibility of recording images, enabling more detailed reporting in the patient's electronic file and comparison of images during follow-up.
- Light source (LED).
- Decontamination system: enzymatic detergent, glutaraldehyde, or a noncorrosive solution, based on brand and manufacturer recommendations.
- Topical decongestant.
- Anaesthetic spray.
- Lubricating gel.
- Antifog solution or alcohol wipes.
- Tissues.

If biopsy, endoscopic procedures, or Fibre-optic Endoscopic Evaluation of Swallowing (FESS) are being performed in office, the following are also required: adequate forceps or instrumentation, 5 cc Lüer-lock syringe, an aspiration system and liquids, thick liquids (nectar and honey-like), puree, solids, and mixed consistencies.

FN remains difficult to perform in resource-limited settings due to the high cost of purchasing and maintaining equipment as well as the need for specialists to interpret exam findings. The lack of expertise can be obviated by adopting telemedicine-based approaches [1] and the capture,

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storage, and sharing of images/video can be replaced by a smartphone that can fulfil the same functions but at a lower cost [2].

Institutions without the high-definition equipment detailed above usually rely on the older flexible fibrescopes. These can be connected via a separate attachable camera head to a stack system if photographic or video documentation is needed.

1.3 Set-Up

The visualisation of the mucosal surfaces of the upper aerodigestive tract (UADT) necessitates a clear image unhindered by either equipment, patient, or operator factors. To obtain the best view, the variables about examination must be kept to a minimum. To this end, the patient must be still and so must be properly anaesthetised and comfortable. The operator must also be adept at anaesthetising the patient sufficiently, operating the equipment, and performing the procedure.

Anaesthetising the patient's UADT sufficiently to gain a clear view of anatomy is important. This allows visualisation of the laryngeal ventricles, subglottis, and post-cricoid areas that can be very difficult to approach endoscopically without anaesthesia.

Many options are available. However, the basic tenets of decongestion and time should be adhered to. Decongestion of the nose is helpful to allow easy passage of the endoscope through the nose, and sufficient time must be allowed for the anaesthetic to work—the speed of response to topical anaesthesia in the general population is a bell-shaped curve—and it may take 10–15 min for some patients to be completely anaesthetised.

The patient should be sat in a chair with a head rest and an ability to lie flat in the case of a vaso-vagal attack. If one is not available, then a chair pushed back against the wall is a reasonable alternative. The head rest or wall restricts the patient's head from moving during examination.

The operator should stand in front of the patient. If seated, the operator should come alongside the patient with the lateral aspect of both operator's and patient's knees in proximity (i.e. right knee to right knee). Sitting in front of the patient means the operator has to lean forward to gain a view putting undue strain on the back.

Ideally, there will be a screen to view the endoscopic image on as per the equipment list above. This should be placed next to the patient facing the operator so that the clinician does not have to turn their head to see it. If the operator is looking down an eye-piece, then the second eye should be kept open—this will allow the operator to see any movement of the patient and adjust accordingly.

1.4 Use of Endoscope

In Head and Neck Oncology, the use of the FN in the evaluation of patients is used mainly by ENT and Maxillofacial surgeons or by trained physicians who manage the upper airway in the operating room or the intensive care unit setting. It is also useful in voice consultation, and as part of the FEES in conjunction with the speech and language therapists. FEES allows the examiner to identify swallowing physiology, determine the safest and least restrictive level of oral intake, implement appropriate compensatory techniques, and identify a dysphagia rehabilitation plan [3]. FN is generally well tolerated by adults, infants, and children.

The appropriate care of the FN is of utmost importance; therefore, all users should be familiar with proper cleaning and storage. Scopes are sturdy but not indestructible; thus, bending the scope at tight angles should be avoided and high-level decontamination achieved before and after usage as required depending on brand and manufacturer. Storage must be in a safe place.

Sterile disposable sheaths are custom-built for a variety of scopes and models and even come with a working channel. The tip of the sheath must be fully slid onto the scope so that the special optical element at the end lies flat against the tip of the scope. Nowadays, with the advent of the Covid-19 pandemic, even disposable single use scopes are readily available at low prices for its use whenever necessary.

1.5 Aims of Endoscopy

1.5.1 TNM and Cancer Mapping

When performing endoscopy, one needs to think about the information that is needed from the examination. This will be complementing the history that has already been taken to allow accurate and individualised management plans to be formed. In the case of benign pathology, the questions that need answering may include "is the vocal fold cyst epithelial or epidermoid?' The answer to this may not be obvious unless other visualisation modalities are employed such as stroboscopy (Sect. 1.7.2). It will also change the surgical planning. If the pathology is papillomatosis, the question will be "how extensive is the disease?" This will ensure that the correct visualisation techniques are used such as ensuring a view into the trachea and subglottis. In the case of potentially malignant pathology, the extent of disease is a major factor in the prognosis as it is a constituent part of the TNM classification. For example being able to see into the laryngeal ventricles or subglottis may allow the differentiation of a T1a and a T2 cancer of the larynx.

Table 1.1 T staging of laryngeal cancer for the public

Tis (tumour in situ) the cancer is very early. It is contained in the top layer of the skin like covering of the larynx (mucosa). It has not spread into any surrounding tissue
T1 the tumour is only in one part of the larynx, and the vocal cords are able to move normally
T2 the tumour, which may have started on the vocal cords (glottis), above the vocal cords (supraglottis), or below the vocal cords (subglottis), has grown into second part of the larynx
T3 the tumour is more bulky and has caused one of the vocal cords to not move (your doctor may describe it as fixed). OR the tumour has grown into nearby areas such as the tissue in front of the epiglottis (pre-epiglottis tissues) or the inner part of the thyroid cartilage
T4 means the tumour has grown into body tissues outside the larynx. It may have spread to the thyroid gland, windpipe (trachea), or food pipe (oesophagus)

The latest iteration of the TNM classification for head and neck cancers can be ordered via the UICC website (https://www.uicc.org/news/8th-edition-uicc-tnm-classification-malignant-tumors-published) and should be available in every cancer centre (Table 1.1). Cancer Research UK has an overview of all the TNM classifications for head and neck cancer in their easy-to-use website here: https://www.cancerresearchuk.org/about-cancer/head-neck-cancer.

For any suspected cancer, good visualisation with estimated measurements of the lesion and an accurate position is essential. This will give clinical information to add to the radiological and histological findings. In some cases, accurate visualisation will give more information than radiological investigation. For example the knowledge that a cancer has spread from the vocal fold into the ventricle or subglottis can be accurately assessed with endoscopy but may not be easily demonstrated on cross-sectional imaging.

It is the author's contention that having the ability to put these clinical pictures forward at an MDT discussion gives a clear picture of the lesion being discussed. Some imaging systems have the connective capability to upload the images to the radiology imaging system so that they can be reviewed in the same way that the patient's scan can be.

1.6 Techniques for Visualization

1.6.1 General

Indirect laryngoscopy involves multiple pieces of equipment working synchronously combined with good operator technique and the weakest point will determine the quality of the image you get.

Factors that can affect the quality of your image, and that can be easily checked and corrected if necessary, include

- Level of illumination
- Cleanliness of the lens
  - Focus
  - White balance
  - Image centred on the area of interest

Factors that cannot be altered by the clinician include

- Resolution of the camera and screen
- Quality of the endoscope

Therefore, before starting endoscopy, one should check the equipment (including recording equipment if being used) and the area you are using for endoscopy. The three main areas to check are the endoscope itself, the position of the examiner, and the processor, if being used. The processor or light source is turned on, the patient's details entered, and the strobe or NBI adjuncts checked if they are to be used (discussed later in the chapter).

The endoscope is plugged in, the image is focussed, is aligned on the monitor, and finally white balanced. One can also colour check endoscopes with a test chart if this is available.

Finally, the examiners put themselves in a comfortable position, either standing or sitting, with your head in a position so that you can see the patient and the monitor screen at the same time. If you are using an eyepiece endoscope rather than a monitor, you should learn to perform the examination with both eyes open so that the non-dominant eye will pick up movements or cues from the patient during examination.

It takes very little time to learn when the image you have is either too bright or dark, or unfocussed, or rotated, or the lens has fluid on it. All these aspects can be quickly corrected and will give you an excellent image.

Endoscopes with side-channels have a greater diameter (up to 6 mm) but can still pass through the nose of adults with adequate decongestion and anaesthesia.

1.6.1.1 Vaso-vagal Attack

The clinician may come across a patient who will have a vaso-vagal attack during endoscopy. The patient will start feeling faint, and when you look at their face, they will have become very pallid. Lie the patient down on the floor immediately to prevent syncope and lift their legs, resting them on a chair until they feel better. Usually, with time, the patient can still have an endoscopy without having the same reaction. However, there will still be patients who will be unable to have endoscopy without having a vaso-vagal attack. With an amenable patient, it may be possible to perform FN with the patient lying down (Fig. 1.1).

1.6.1.2 Holding the Endoscope

There are many types of endoscope on the market. Some are designed to be held in a specific way, and some can be held

Fig. 1.1 Performing FN (with stroboscopy) on a patient who was unable to be examined sitting without a vaso-vagal attack. The examination was performed with the patient lying down and was successful as can be seen by the image of the larynx on the screen

in different ways. The three main ways of holding and manipulating the flexible tip are

1. Underhand with index finger control (Fig. 1.2a)—body of endoscope held in the thenar space, manipulated with the index finger. The old fibrescope is usually held in this way
2. Underhand with thumb control (Fig. 1.2b)—body of endoscope held in handshake grip, manipulated with the thumb
3. Pistol grip (Fig. 1.2c)—body of endoscope held in handshake grip, manipulated with the index finger or thumb depending on make

Almost all endoscopes now have a variety of controls on the body that can be programmed to take still images or videos or switch to other light modes such as NBI or stroboscopy. It needs some practice to determine which combination is the right one for you and your practice and these buttons can be programmed to suit your needs. For example a head and neck surgeon may primarily use videos, still images, and NBI, whereas a laryngologist may also add stroboscopy.

When using an FN, one must be neither too close nor too far away from the patient. Being too close may be uncomfortable for the patient but will constrain the endoscope and make control more difficult. Being too far away means that the examiner will be leaning forward, putting strain on the lower back, and the endoscope will be so straight that manipulation will also become more difficult. A happy medium with the examiner in a position of comfort and a straight back, with some "give" in the endoscope will allow the endoscope to be rotated and manipulated without tension.

Place the little finger of your non-dominant hand on the cheek of the patient to steady the scope in relation to the patient. The dominant hand will be holding the body of the scope and utilising the control buttons.

1.6.1.3 Anaesthesia

In the author's view, the best images can only be obtained with regularity with adequate anaesthesia. The areas that need particular attention are

The nasal airway
The oropharynx (especially if the patient has a strong gag reflex)
The larynx

A good combination that usually covers all these areas is co-penylcaine spray, a combination of 5% lidocaine and 0.5% phenylephrine, applied in both nostrils and allowed to work for a couple of minutes. Remember that local anaesthetic works at different speeds in different people, so checking that the patient's throat is numb (feels like "cotton wool") before examination should be done before starting.

To anaesthetise the larynx specifically, lidocaine 2% or 4% can be sprayed per os with a 90° angle on the nozzle (Fig. 1.3) so that it points inferiorly. Ask the patient to say a long "eee" and spray whilst they are phonating, not when they are breathing—this will cause severe coughing. Endoscopes with a side-port can be used to dribble some 2% or 4% lidocaine onto the laryngeal surface of the epiglottis. This will run down to the anterior commissure and into the ventricles. This gives excellent laryngeal anaesthesia.

The oropharynx can be anaesthetised very effectively using a spray of 10 mg xylocaine apray onto the left anterior faucal pillar, the velum, and then the right anterior faucal pillar. The patient can swallow the spray once administered and this will also help the hypopharyngeal anaesthesia.

1.6.2 Nose/Nasopharynx

Since the improvement experienced of FN visualisation with the introduction of the chip-on tip technology, the interest for rigid nasal endoscopy examination has experienced a decay among ENT surgeons. The ease of use and the ability to manipulate the flexible endoscope easily into narrow recesses makes it possible to examine certain areas of the nasal fossae

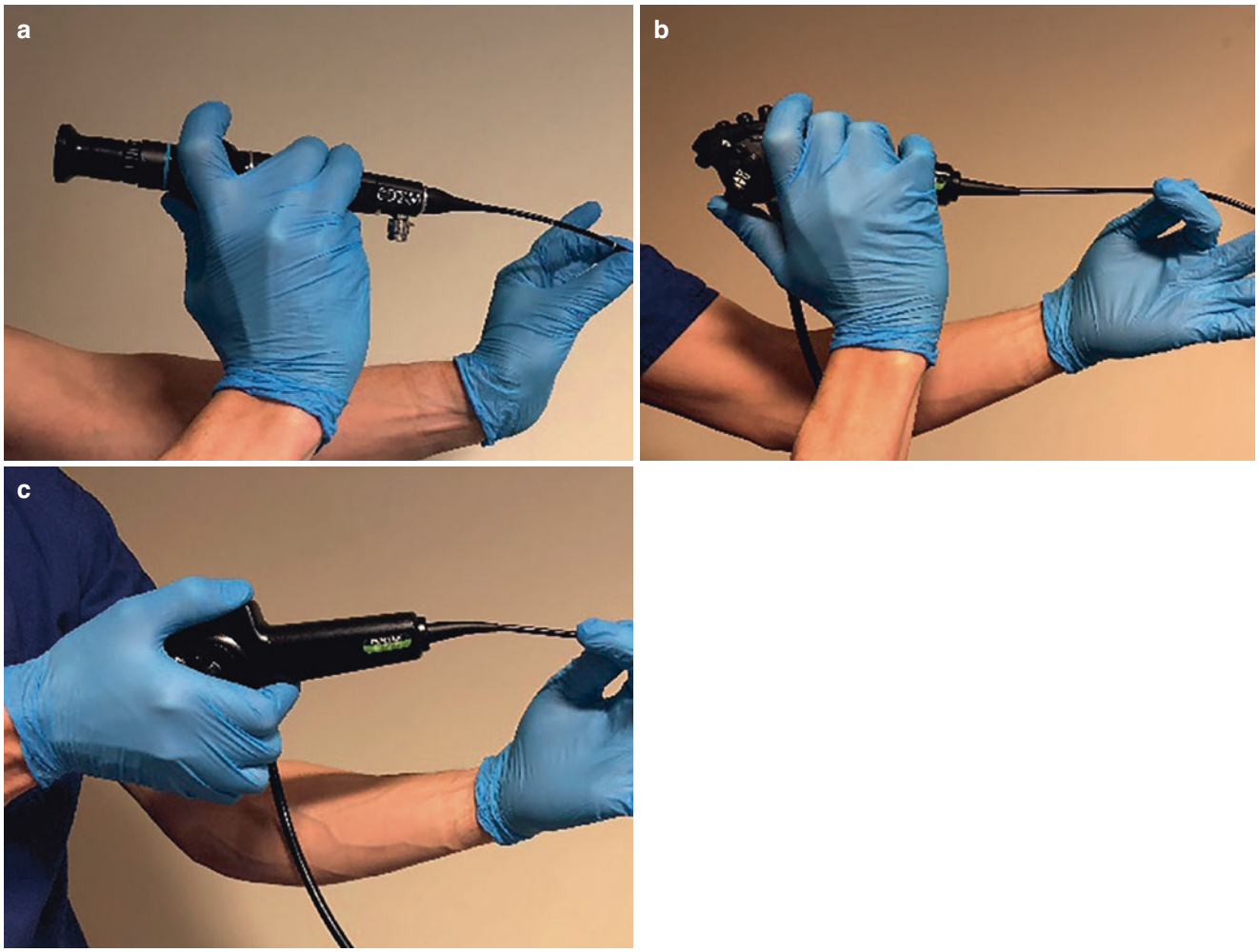

Fig. 1.2 (**a**) Underhand index finger. (**b**) Underhand thumb. (**c**) Pistol (thumb or index finger)

Fig. 1.3 Local anaesthesia; co-phyenylcaine spray (*left*), xylocaine (lidocaine) 10 mg spray (*right*)

and paranasal sinuses, such as the sphenoethmoidal recess, the anterior wall of the maxillary sinus (in patients who have had previous surgery), and the sphenoid sinus.

1.6.2.1 Technique

The patient is positioned comfortably, sitting upright with a firm headrest they can lean their head against, and after first examining the nose via anterior rhinoscopy. For nasal endoscopy, the patient's nose should be prepared by applying a topical local anaesthetic with a decongestant, to anaesthetise the nasal cavity (tetracaine with adrenaline) into each nasal cavity, which should be left for at least 5 min before attempting any instrumentation, to allow sufficient time for the anaesthetic and vasoconstrictive effect to take place.

The scope is prepared first by coating the lens with a thin layer of anti-fog solution. To be comprehensive, the examination should be undertaken in an orderly fashion. This can be accomplished by dividing the exam into three passes on either side. With each pass, the condition of the nasal mucosa and normal anatomical structures is examined: anatomical variations or intranasal pathologies are carefully noted down.

During the first pass, the endoscope is introduced along the floor of the nasal cavity, between the inferior turbinate and the septum, towards the choana. This first pass allows examination of the inferior part of the nasal cavity including

the inferior meatus where the nasolacrimal duct drains, and the nasal septum, as well as the nasopharynx and Eustachian tube openings, which should be tested for adequate patency asking the patient to swallow or to perform a Valsalva manoeuvre. A special attention is paid to the fossa of Rossenmuller, origin for early undifferentiated nasopharyngeal carcinoma. Presence in the nasopharynx of adenoidal nests or any untoward mass in adults usually warrants further investigation (Fig. 1.4).

The endoscope is then withdrawn and gently reinserted for the second pass between the middle and inferior turbinate, to examine the middle meatus. It is during the second pass that the lateral nasal wall is inspected including the maxillary line and attachment of the middle turbinate. The middle nasal meatus normal anatomy comprehends the presence of the middle turbinate and the osteomeatal unit where the frontal, maxillary, and anterior ethmoid sinus drain all together. The following anatomical landmarks should be

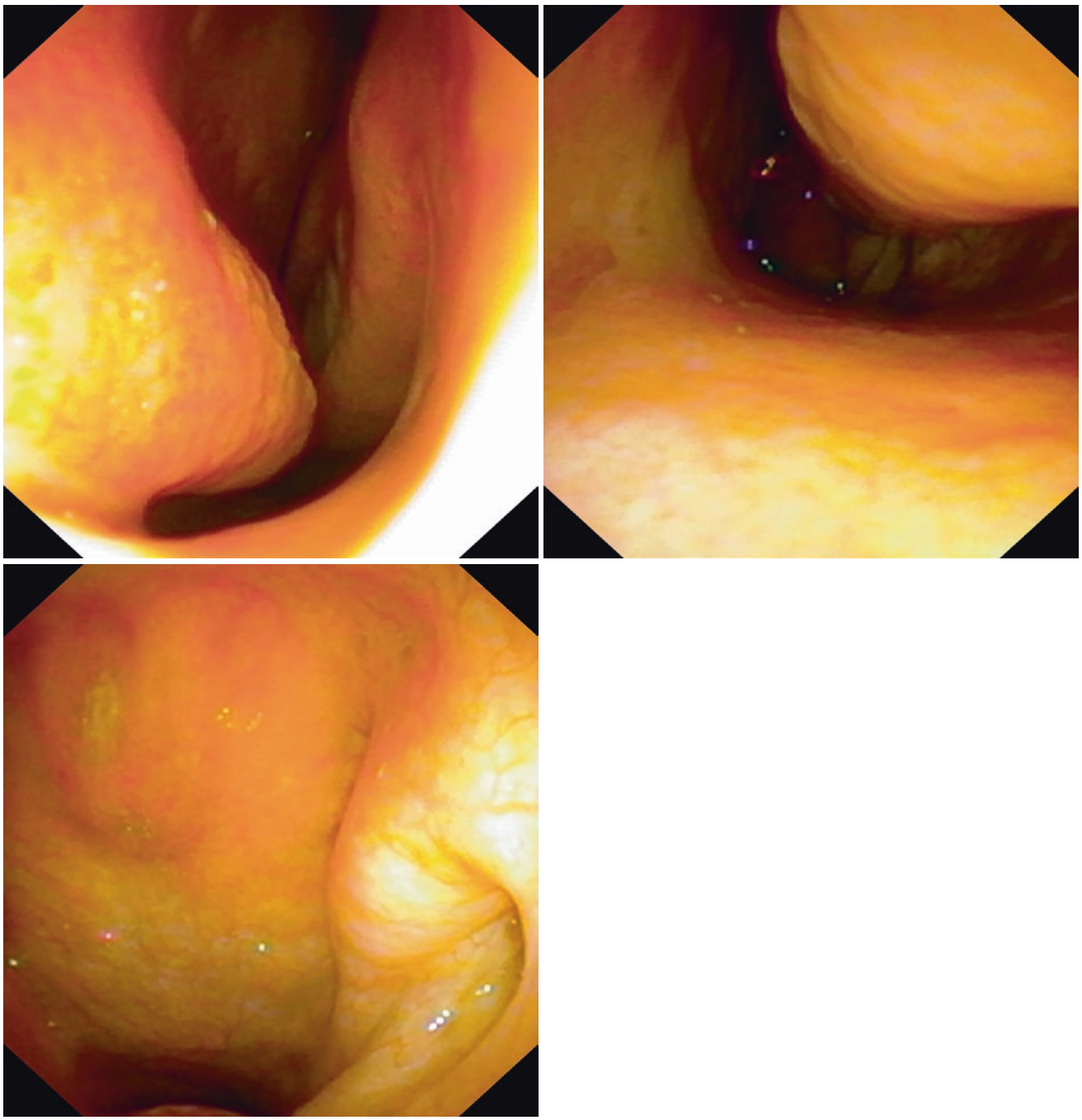

Fig. 1.4 Presence in the nasopharynx of adenoidal rests or any untoward mass in adults usually warrant further investigation

identified: maxillary ostium, uncinate process, infundibulum, hiatus semilunaris, ethmoid bulla, and frontal recess. Injected hyperemic tissue is not unusual, but occasionally, tissue may look normal despite inflammation in the sinuses. This can occur when there is complete obstruction of the ostiomeatal unit. Care must be taken not to inflict more pain than necessary on attempting to visualise the middle meatus. Swelling and inflammation with reduction in size of the meatus may significantly compromise the ability to examine this area. Inflamed turbinates may swell enough to compromise the meatus. This anatomical site could be the origin of pseudotumours arising within the maxillary sinus (mucoceles, polyps), inverted papillomas, carcinomas, etc. (Fig. 1.5).

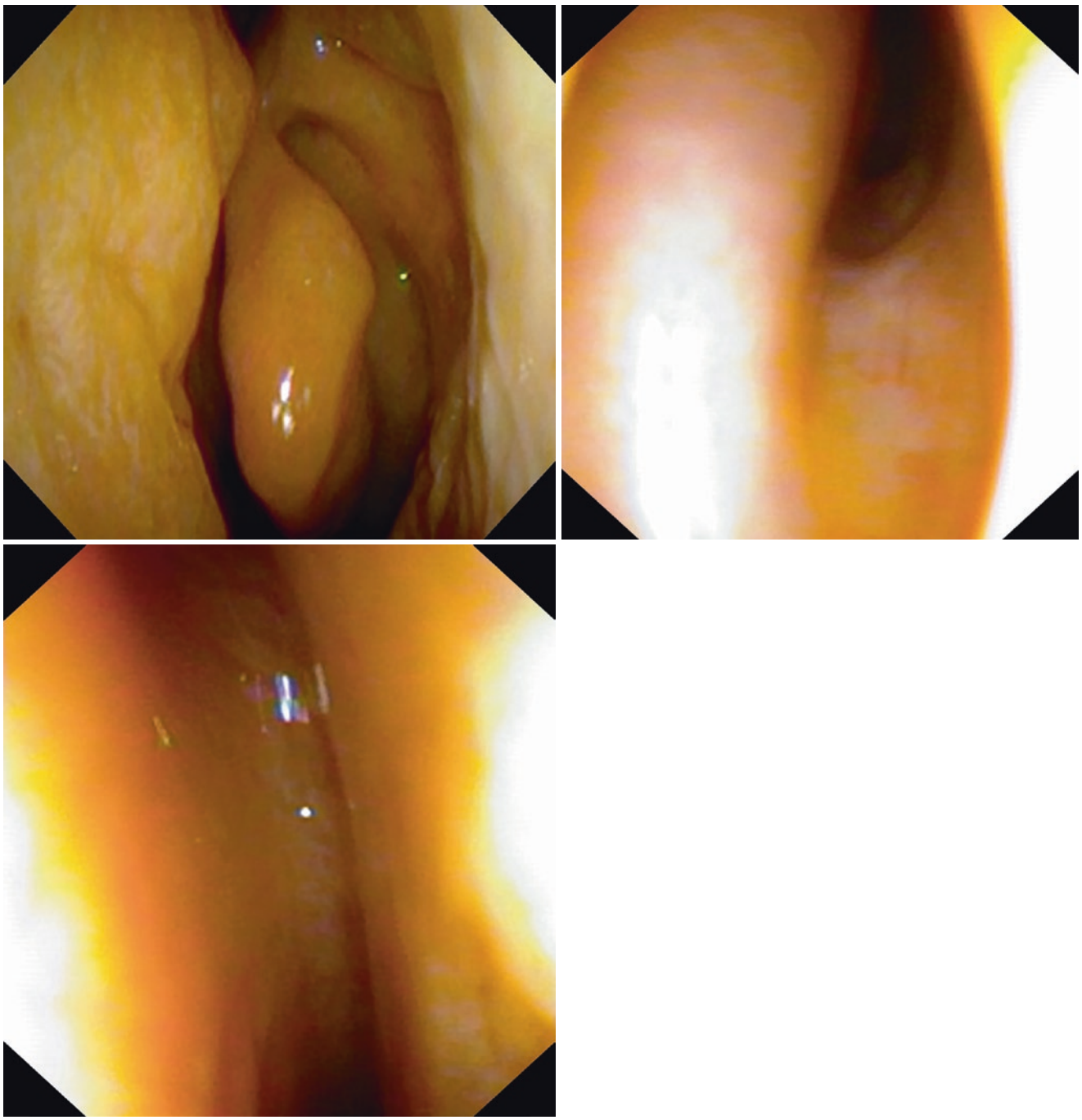

Fig. 1.5 Swelling and inflammation with reduction in size of the meatus may significantly compromise the ability to examine this area. Inflamed turbinates may swell enough to compromise the meatus. This anatomical site could be the origin of pseudotumours arising within the maxillary sinus (mucoceles, polyps), inverted papillomas, carcinomas, etc.

For the third pass, the endoscope should be gently manoeuvred medial and posterior to the middle turbinate to examine the sphenoethmoid recess where the posterior ethmoid and sphenoid sinus drain. The sphenoethmoidal recess and choana can be inflamed as well as a result of drainage through the posterior ethmoid or sphenoid sinus where inflammation is sometimes present. To improve exposure at the sphenoethmoidal recess deflecting the tip of the endoscope superiorly, one should be able to visualise the superior turbinate and possibly the sphenoid sinus ostium. Less commonly, the posterior ethmoidal ostia may also be visualised.

1.6.3 Oropharynx

Some of the oropharynx can be visualised through the oral cavity examination. However, the base of tongue, vallecula and often the oropharyngeal areas posterior to the posterior faucal pillars can only be properly assessed using endoscopy.

On passing the endoscope through the posterior choanal channel and the nasopharynx, the oropharynx is seen. The areas of most concern in the oropharynx with respect to head and neck cancers are the tonsils and the base of tongue. In many patients with normal anatomy (and especially in those with wasting of the intrinsic muscles of the tongue), the vallecula and subsequently the base of both tonsils can be seen quite easily once the scope has passed through the nasopharynx and is at the top of the oropharynx.

However, the image will always be skewed by which nostril the scope has been passed through. It is imperative that one rotates the flexed tip of the scope to the contralateral side to ensure that the opposite side has been assessed. For example passing the scope through the right nostril allows a good of the right base of tongue and tonsil. One should then flex the tip of the scope anteriorly towards the mouth and rotate the body of the scope in an anti-clockwise direction to view the left tonsil and vallecular (Fig. 1.6).

It is usual to need to ask the patient to stick out their tongue to assess the vallecula as the base of tongue and the lingual surface of the epiglottis are often very close or touching. Another way is to ask them to adopt a prognathic position by jutting their chin forward and putting the tip of their tongue in front of their upper incisors.

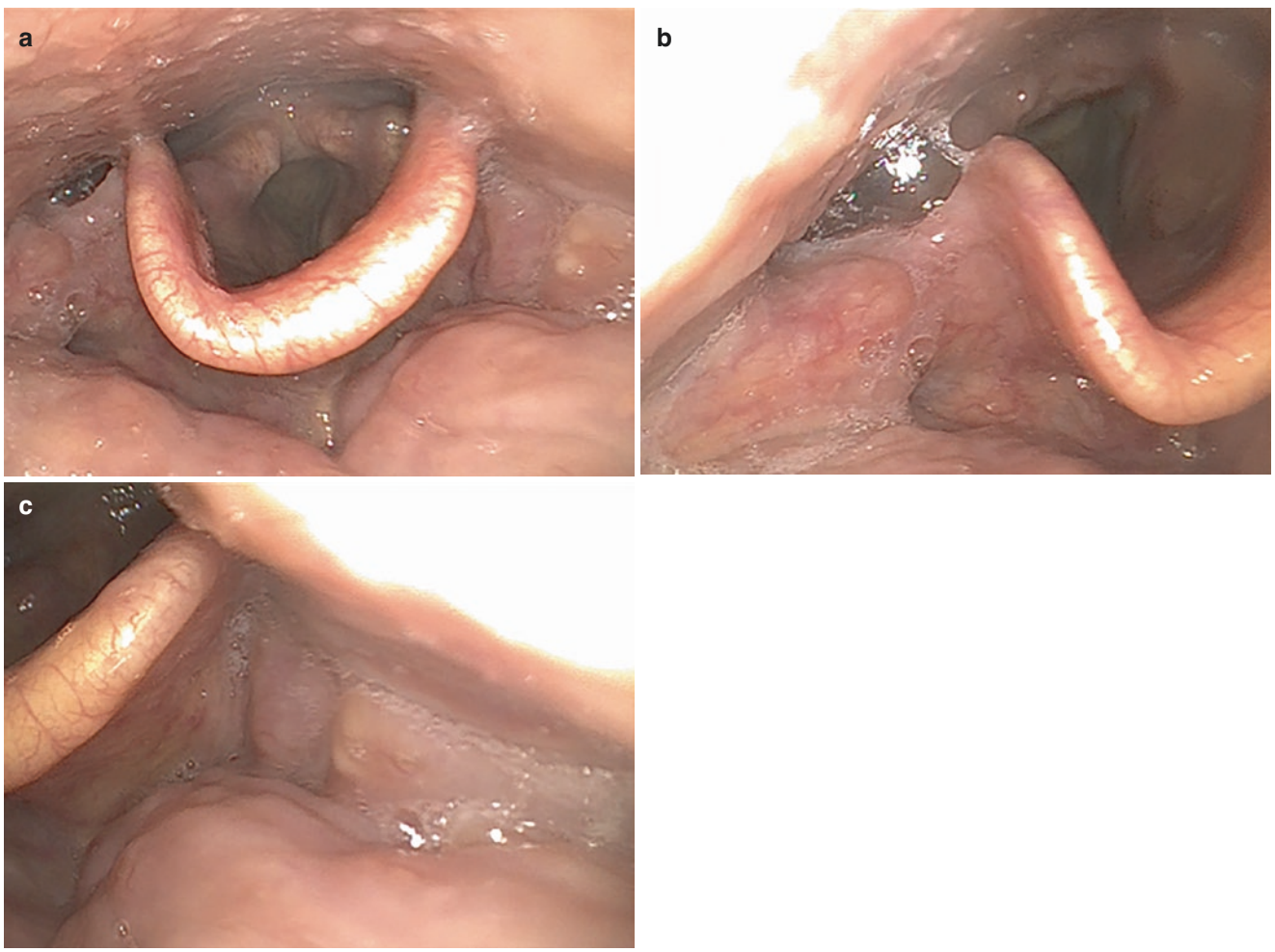

Fig. 1.6 (**a**) Central view. (**b**) Rotated to right tonsil. (**c**) Rotated to left tonsil

1.6.4 Hypopharynx Especially the Postcricoid Region

Hypopharyngeal cancer which represents approximately 7% of all Squamous Cell Carcinomas of the Head and Neck (SCCHN), is often asymptomatic until it reaches the advanced stage, when may account for poor prognosis compared with other SCCHN [4]. Notably, hypopharyngeal cancer has the highest risk of second primary cancer among SCCHN, particularly the development of synchronous or metachronous oesophageal cancer, which is associated with the same carcinogens [5]. Although endoscopic screening failed to document survival benefits, early detection of hypopharyngeal cancer has yielded a significantly higher rate of larynx preservation, which may have contributed to improving the quality of life in these patients [6].

The goal of flexible endoscopy examination of the hypopharynx is to achieve observation of the entire circumference of the hypopharyngeal space, including both pyriform sinuses, postcricoid region, and upper oesophageal sphincter, even in patients receiving radiotherapy.

1.6.4.1 Technique

In order to achieve the proposed goal, the procedure is performed with the patient in a normal seated position. The head is rotated laterally to either side and the patient is asked to phonate "e" in all positions. Then, from a normal seated position, the patient's neck is bent forward and the chin depressed far enough so that the patient is able to look down at the umbilicus (Killian's position). Finally, a Valsalva balloon-blowing manoeuvre is performed at all head positions (normal, torsion to either side and Killian's), which consists in forcing air into the cheeks as if blowing a balloon whilst closing the mouth, without allowing air to escape through the mouth or nose. Any pooling of saliva, fullness, masses, or mucosal ulcerations seen warrants further investigation (Fig. 1.7).

1.6.5 Larynx

Areas of the larynx that need assessment are the laryngeal surface of the epiglottis, the aryepiglottic folds, the arytenoids, the interarytenoid space, the false vocal folds, the true vocal folds up to the anterior commissure, and the laryngeal ventricles.

To view all of this in one view is not possible and some tricks must be employed. Due to the fine focus of the endoscope, the epiglottis and the vocal folds will not be in focus at the same time. Focussing the endoscope prior to use at about 4 cm is usually adequate for a good-quality image but means that one must advance the endoscope when examining to view firstly the superior end of the epiglottis and the laryngeal surface before the vocal folds come into focus. This means that if you are "tumour mapping," you may need multiple images.

Advance the scope so that the vocal folds fill almost the whole view. Ask the patient to gently sniff and the vocal folds will abduct slightly (if they sniff too hard the vocal folds may adduct so a gentle sniff only is needed). Then ask the patient to gently say "eee" and the folds will adduct. You will be able to assess movement of both folds, asymmetries and see if there are any lesions. This will also allow assessment of the dynamic function of the larynx and hypopharynx as a unit. On phonation and swallowing you will be able to see whether movements in both the laryngeal and perilaryngeal areas are symmetrical. Asymmetry may indicate a submucosal lesion and would warrant further investigation.

If you are uncertain whether an area on the vocal fold is thick mucus or a discrete lesion ask the patient to clear their throat or gently cough. This will clear or at least move mucus secretions.