Clinical Surgery

EAR NOSE AND THROAT

CONSULTANT EDITOR

MAXWELL ELLIS

CLINICAL SURGERY

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CLINICAL SURGERY

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PREFACE

This volume is by no means a complete textbook on diseases of the ear, nose and throat and is meant to include only those conditions where surgical treatment is at some stage desirable or essential. The contributors have attempted a practical outlook which it is hoped will serve as an adequate guide to those who, by force of circumstances, work alone and have little opportunity of consultations with colleagues. Several conditions are described which are rarely seen in this country but on which surgeons elsewhere may need guidance. These include some specifically regional diseases and also late or serious complications of infections.

No account of nasal injuries and cosmetic disabilities of the nose and ears has been included, although these are conditions which the modern ear, nose and throat surgeon is often called upon to treat. They are described in other volumes of this series.

The allocation of space has been difficult, as the management of some quite serious diseases is relatively straightforward, whilst others present many problems. For operative details the reader is referred to *Operative Surgery*.

January, 1966 MAXWELL ELLIS

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CHAPTER 1

METHODS OF EXAMINATION OF THE EAR

KENNETH McLAY

The symptoms which are most likely to occur in ear disease are deafness, otorrhoea, earache, tinnitus or vertigo or a combination of these. Where such symptoms occur, methodical examination of the ears is required after obtaining the history of the condition.

THE EXTERNAL EAR

First the pinna is examined for the presence of swelling or tenderness, which may be due to such conditions as dermatitis, perichondritis or haematoma. The scars of previous operations are noted. Postaural scars are usually easily seen, but the scar of an endaural incision between the tragus and the helix is easily overlooked.

The site of any postaural tenderness is noted and if postaural swelling is present it is important to observe whether the postaural groove is obliterated, a sign which indicates local cellulitis rather than the subperiosteal abscess of mastoiditis.

Any enlargement or tenderness of the pre-auricular, post-auricular or infra-auricular lymph nodes is noted.

THE EXTERNAL AUDITORY MEATUS

The external auditory meatus is examined, using an aural speculum of suitable size. Illumination is provided by a bull's eye lamp and the light focused into the ear by a forehead mirror (*Figure 1*). An electric auriscope is usually preferred by those who are unaccustomed to the use of a forehead mirror, but the latter is preferable for general specialist use, as it frees both hands for any necessary manipulations.

Discharge in the meatus is removed by syringing, by mopping or by suction under direct vision. Wax is removed with a hook or loop under direct vision or by syringing, after softening with olive oil. Adequate cleaning of the meatus is essential to obtain an adequate view.

Any narrowing or tenderness of the meatus is noted, and whether this is due to the shape of the bone or to swelling of the meatal skin or a polypus can be determined by the gentle use of a fine probe.

THE TYMPANIC MEMBRANE

Inspection of the tympanic membrane is usually best achieved by traction on the pinna outwards, upwards and backwards. This brings the outer meatus into line with the inner meatus. In young children the meatus may be better seen by drawing the pinna downwards and backwards and it is often possible to inspect the tympanic membrane in an infant in this way without the use of a speculum.

The main landmark on the tympanic membrane is the handle of the malleus which passes downwards and backwards from the attachment of the short process above to the umbo below, which lies approximately in the centre of the drum. The pars tensa of the tympanic membrane is divided

Figure 1.—Method of examining the ear.

into four quadrants for descriptive purposes. The upper half is divided into an antero-superior and a postero-superior segment by the handle of the malleus. The lower half is divided into an antero-inferior and a postero-inferior segment by an imaginary line dropped vertically from the umbo to the periphery.

Above the short process and the anterior and posterior malleolar folds is Shrapnell's membrane or membrana flaccida, which forms part of the outer wall of the attic.

Radiating downwards and forwards from the umbo is the cone of light, caused by the reflexion of the examining light on the outer conical surface of the obliquely lying tympanic membrane, which is closest to the examiner in its postero-superior segment and most distant in its antero-inferior segment.

If the tympanic membrane is thin the long process of the incus may be seen through it. Sometimes the niche of the round window can be made out.

The tympanic membrane should be examined for loss of its normal lustre, for indrawing or bulging, for the presence of fluid in the middle ear and for mobility. Siegle's magnifying speculum, by which the air pressure in the external auditory meatus can be raised and lowered, causing the membrane to move inwards and outwards, is the best method of testing for mobility, and should invariably be used. The size, extent and site of any perforation—and whether or not discharge can be sucked through it by the Siegle speculum—should be noted. A perforation closed by a thin scar is easily mistaken for a patent perforation unless the mobility of the scar is demonstrated by this instrument.

The presence of granulations or cholesteatoma is also noted. In many cases normal otoscopic examination should be supplemented by examination of the ear under *magnification*, using a binocular stereo-microscope with a magnification of six or ten. A more accurate assessment of the state of the tympanic membrane and middle ear structures is thus made possible.

THE EUSTACHIAN TUBE

Patency of the eustachian tube is best demonstrated by examination of the tympanic membrane with Siegle's speculum while the patient performs Valsalva's manoeuvre. Where the tube is patent the drum is seen to move as air enters the middle ear.

If Valsalva's manoeuvre is not successful the eustachian tubes should be inflated by eustachian catheterization, the examiner listening with an auscultating tube (described under eustachian conditions).

No examination of the ear is complete without a careful examination of the nasal cavities, nasopharynx and pharynx.

TESTS OF HEARING

The simplest form of assessment of hearing is the measurement of the distance at which the patient can hear a whispered voice with the opposite ear occluded. If he cannot hear a whispered voice, the distance at which he can hear a normal conversational voice is measured. If he fails to hear a conversational voice close to the ear, it is noted whether he can hear a raised voice at the ear. Failing this, a loud shout is used. Where a conversational voice or louder is used close to the ear, it is essential that the opposite ear be prevented from hearing the voice. This masking is provided by a Bárány box, a clockwork noise generator, or in young children by the rustle of a sheet of paper sliding over the opposite ear.

Tuning Fork Tests

The basis of tuning fork tests is a comparison of sound generated by a tuning fork as it is conveyed to the inner ear by air conduction or bone conduction. Air conduction is the normal pathway through the drum and ossicles and, as one would expect, is more efficient than sound transmitted through bone to the cochlea, when the sound conducting apparatus is normal.

Rinne's test

A tuning fork with a frequency of 256 or 512 c/s is used. It should be heavy enough to have a decay time of about 30 sec., and it should have a broad base for application to the skull. The tuning fork is set in vibration by striking it against a resilient object. The tuning fork is then held so that its acoustic axis is in line with the external auditory meatus. The patient is then asked to signal as soon as he ceases to hear the sound, when the base of the fork is immediately transferred to the mastoid process. If he again hears the sound, bone conduction is better heard than air conduction, a lesion in the sound conducting pathway is present and Rinne's test is said to be negative. If he does not hear the sound by bone conduction the procedure is reversed, applying the tuning fork to the mastoid process first. If he hears better by air conduction than by bone conduction the sound conducting pathway is normal or there is a minor loss of sound conduction of not more than 17 dB.

Absolute bone conduction

In this test, the patient's bone conduction is compared with the examiner's bone conduction, which is assumed to be normal. Sound applied to the mastoid process is transmitted directly to the cochlea through the bone and therefore by-passes the normal conducting pathway. It is thus an assessment of inner ear function.

A tuning fork is struck and applied to the patient's mastoid process with the external auditory meatus occluded. He is asked to signal as soon as he can no longer hear the sound. The tuning fork is then applied to the examiner's mastoid process with his meatus occluded. Where the hearing is normal, the patient will hear the sound as long as the examiner. Where there is a perceptive deafness, the examiner will continue to hear the sound which can no longer be heard by the patient, and absolute bone conduction is said to be shortened.

In some cases of conductive deafness, and particularly in otosclerosis, the patient may hear by bone conduction longer than the examiner and absolute bone conduction is said to be lengthened.

Weber's test

This test is mainly of use in unilateral deafness or in deafness that is asymmetrical.

A vibrating tuning fork is applied to the vertex of the skull in the midline. The patient is then asked on which side he hears the sound. As this is mainly a test of bone conduction, the sound will be better heard on the side with the better bone conduction. Therefore in perceptive deafness the sound will be better heard on the side with better hearing. In conductive deafness, it will be heard on the side with the greater conductive deafness. This is comparable to the lengthened bone conduction in the test of absolute bone conduction.

With these three tuning forks it should be possible to locate with considerable accuracy the site of the lesion causing the deafness. The results can be summarized as given in Table I.

TABLE I

	Rinne	*Absolute bone conduction*	*Weber*
Normal hearing	+ ve	Normal	Central
Perceptive deafness	+ ve	Shortened	Lateralized to better ear
Conductive deafness	− ve	Normal or lengthened	Lateralized to worse ear
Mixed conductive and perceptive deafness	− ve	Shortened	Will depend on degree of conductive and perceptive deafness

AUDIOMETRY

An audiometer is an oscillator which is used to measure the threshold of hearing over a range of frequencies usually from 125 c/s to 10,000 or 12,000 c/s. The available frequencies are at octave or half-octave intervals. The intensity of sound is calibrated in dB with the average normal threshold of hearing at each frequency as the reference level.

Air conduction

The test is started by playing the test tone through an earphone into the better ear at 1,000 c/s. To find the threshold three rules should be observed. The tone should be interrupted frequently. At some stage the patient should be allowed to hear the tone well above threshold, so that he knows exactly what he is listening for. The final threshold should be assessed by increasing the intensity by 5 dB steps, interrupting the tone at each step until the sound is just heard. This procedure is repeated at each frequency and an audiogram (*Figure 2*) is charted. This is repeated on the opposite ear, provided the

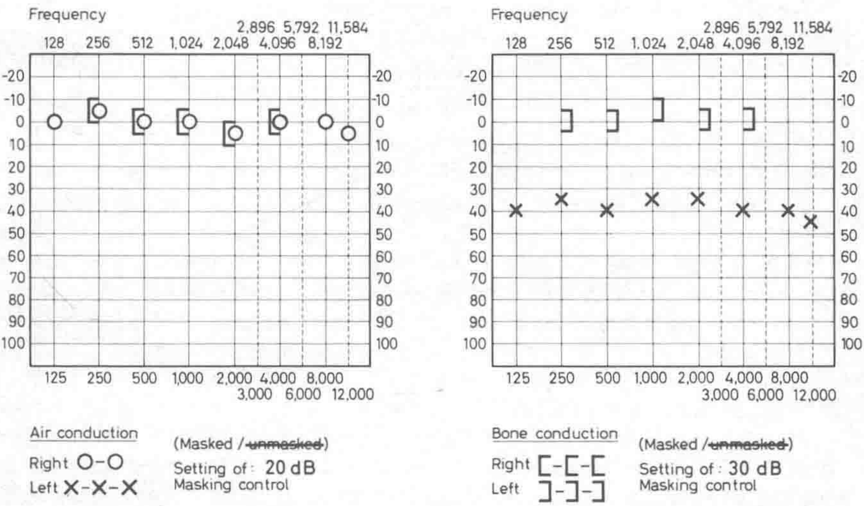

Figure 2.—Audiogram. Normal hearing right ear; conductive deafness left ear.

difference in hearing is less than 30 dB on the two sides. If the difference is 30 dB or greater, the opposite ear must be prevented from hearing the test tone by playing into it a masking noise. If the ear being tested is totally deaf and the hearing in the opposite ear is normal, the test tone will be heard at around 40 dB, depending on the type of earphones being used. There is therefore about 40 dB of attenuation of the test tone across the skull, and this can be used to work out how much masking tone should be applied to the opposite ear.

Masking tones are calibrated according to their ability to mask a pure tone; for example, a masking tone calibrated at 20 dB will mask completely a pure tone of 20 dB played into the same ear. Thus, if a tone of 60 dB is played into the test ear, 20 dB will be transmitted to the opposite ear and 20 dB of masking will be required to mask the sound reaching it. At the present time masking tones usually consist of white noise or a narrow band of white noise with the high and low frequencies, which are not contributing to the masking effect, filtered off.

Bone conduction

The audiometer may also be used to introduce sound to the ear by bone conduction, thus testing the sensitivity of the cochlea and auditory pathway, but by-passing the conducting pathway. Bone conduction intensity is calibrated relative to the average normal bone conduction threshold at each frequency; therefore, where the sound conducting pathway is normal the threshold for air conduction and bone conduction should coincide.

The bone conductor receiver is applied to the mastoid process of the ear to be tested and a 1,000 c/s tone is played so that the patient can hear it comfortably. The patient then moves the receiver until he finds the loudest site. The threshold of hearing by bone conduction can then be measured, within the limits of the audiometer, usually 250–4,000 c/s.

When a tone is played into one ear by bone conduction, it will reach the opposite ear, attenuated by only about 5 dB. It is therefore always necessary to mask the opposite ear, a masking tone of 30 dB being used routinely, but this must be increased if a test tone of greater than 30 dB is being used.

SPEECH AUDIOMETRY

While some patients may be annoyed by their inability to hear door bells or to appreciate music, it is the ability to hear and understand speech which is most important for the majority of people. The understanding of speech can be measured roughly by the whispered voice and conversational voice tests already described. The results of these tests depend very much on the voice of the examiner, the acoustics of the room in which the test is carried out, and on the type of words used. Speech audiometry has been used to compensate for these variables.

Recordings of word lists are played on a gramophone disc or tape recorder. These word lists are phonetically balanced, that is, the speech sounds occur with the same statistical incidence as in normal speech. Alternatively, lists of spondee words, for example a̅rmcha̅ir, ga̅tepo̅st, are used. The lists must be well recorded with all the words equally clearly spoken and of equal loudness.

If a record list is played loudly enough to a person with normal hearing through an earphone or loudspeaker, 100 per cent of the words will be heard correctly. If it is played more quietly, a smaller proportion of the words will be heard correctly, and eventually none at all. A graph can be made plotting the percentage of words heard correctly at each amplification of the recording (*Figure 3*, Curve A). If this is repeated with a group of persons with normal hearing an average curve can be obtained which is representative of normal hearing. In a patient who has conductive deafness, a parallel curve (Curve B) is obtained (*Figure 3*), but greater amplification is required. If sufficient amplification is used 100 per cent of the words will be heard. In perceptive deafness, increased amplification will increase the percentage of words heard, but all the words will never be heard correctly. In fact, in some cases further

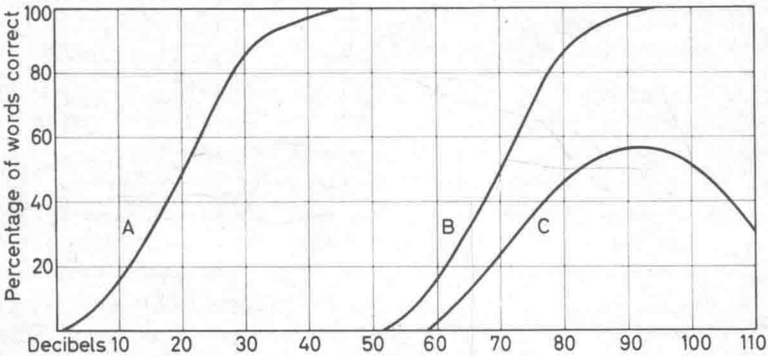

Figure 3.—Speech audiogram. A*: Curve of normal hearing.*
B*: Conductive deafness.* C*: Perceptive deafness.*

increase in amplification will reduce the percentage of words understood because of distortion (*Figure 3*, Curve C).

Speech audiometry can thus be used to distinguish perceptive from conductive deafness, and is particularly useful in discovering whether perceptive deafness is also present in a patient with known conductive deafness.

It is also useful in assessing whether a patient will benefit from a hearing aid. If amplification can allow him to understand 40 per cent of words spoken to him, he will understand 90 per cent of sentences, and this is sufficient for the understanding of speech. It must be remembered, however, that speech audiometry is usually carried out in good conditions with well spoken words and no background noise, and these additional factors may produce a lack of correlation in practice.

Speech audiometry can also be used to assess the performance of a hearing aid in an individual patient. In this case a speech curve is produced using a loudspeaker, first without the aid, and then with the aid fitted.

RECRUITMENT

Recruitment is present when a deaf person hears a quiet sound poorly or not at all, but hears a loud sound as loudly or more loudly than a normal person. It is now widely accepted that this phenomenon is evidence that a lesion is present in the hair cells of the organ of Corti.

Where the deafness is unilateral, recruitment is best demonstrated by Fowler's loudness balance test, in which a test tone is played alternately into each ear. The intensity is kept constant in one ear, but the intensity in the opposite ear is varied until the patient states that the sound is heard equally loudly in both ears. This is repeated throughout a range of intensities and can be best plotted in a ladder chart (*Figure 4*).

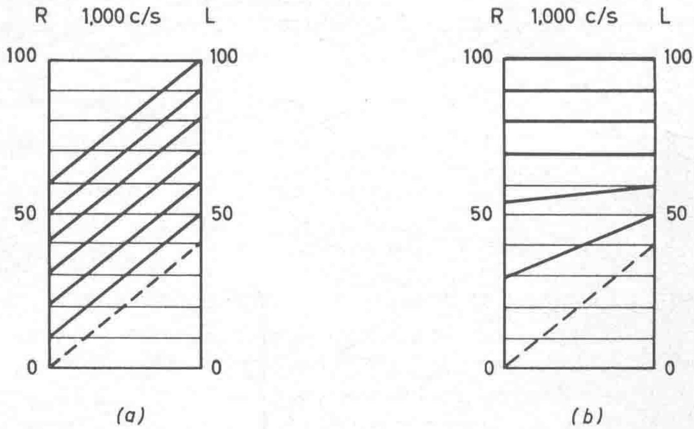

Figure 4.—Loudness balance test: (a) conductive deafness; (b) perceptive deafness with recruitment.

In conductive deafness the deaf ear will always require the same additional intensity before the sounds are appreciated equally loudly. Where recruitment is present a greater intensity will be required in the deaf ear to produce the same perception in both ears when a quiet sound is used as a stimulus in the normal ear. Where a loud sound is used in the normal ear a stage will be reached when the same intensity will produce equal perception in both ears.

BÉKÉSY AUDIOMETRY

Where the deafness is bilateral and symmetrical the loudness balance test cannot be used. Probably the most generally acceptable test of recruitment in these cases is Békésy audiometry. This audiometer is self recording, and plots a tracing around the threshold which is to some extent a measure of the intensity difference limen at threshold. In normal subjects, in those with conductive deafness, and in those with a non-recruiting perceptive deafness, the pen excursion around threshold is about 10 dB (*Figure 5a*). Where recruitment is present there is a marked reduction in the pen excursion to

3 dB or less. This reduction is most often seen at frequencies above 1,000 c/s (*Figure 5b*).

Tests of Vestibular Function

The examination of the vestibular apparatus commences with the demonstration of the presence or absence of spontaneous nystagmus. In a good light, the patient is asked to follow with his eyes the examiner's finger held 2 ft. away.

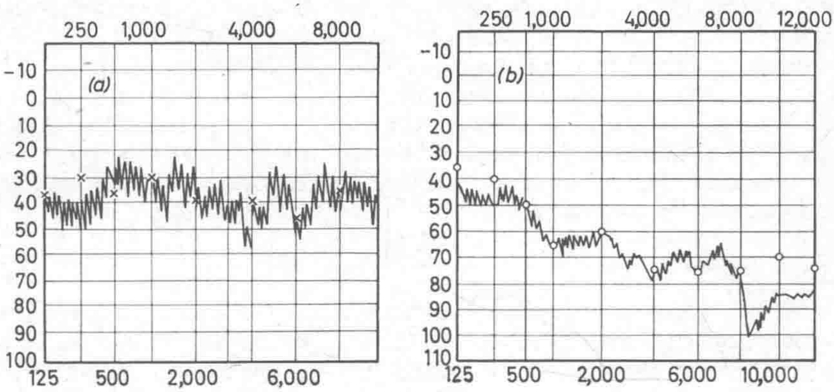

Figure 5.—Békésy audiogram: (a) conductive deafness; (b) perceptive deafness with recruitment.

The patient keeps his head still in the upright position and is made to look straight ahead, to the right and to the left. The direction and degree of any nystagmus is noted. First degree nystagmus is only present when the patient looks in the direction of the quick component. Second degree nystagmus is present when he looks straight ahead and becomes more marked when he looks in the direction of the quick component. Third degree nystagmus is present on looking to the side of the slow component, becomes more marked as he looks straight ahead, and more marked still as he looks in the direction of the quick component. The direction of the nystagmus is named according to the direction of the quick component.

Romberg's Test

Any tendency to fall or sway in a particular direction is noted while the patient stands with the eyes closed and the feet together. Various modifications of Romberg's test are in use. The test is carried out as above but the patient may be asked to turn his head sharply to the right and left. Alternatively the test may be carried out with the patient standing on a board which can tilt laterally in either direction.

Past Pointing

The patient stretches his arms forward in front of him and places his forefingers on the examiner's forefingers. He then raises his hands above his