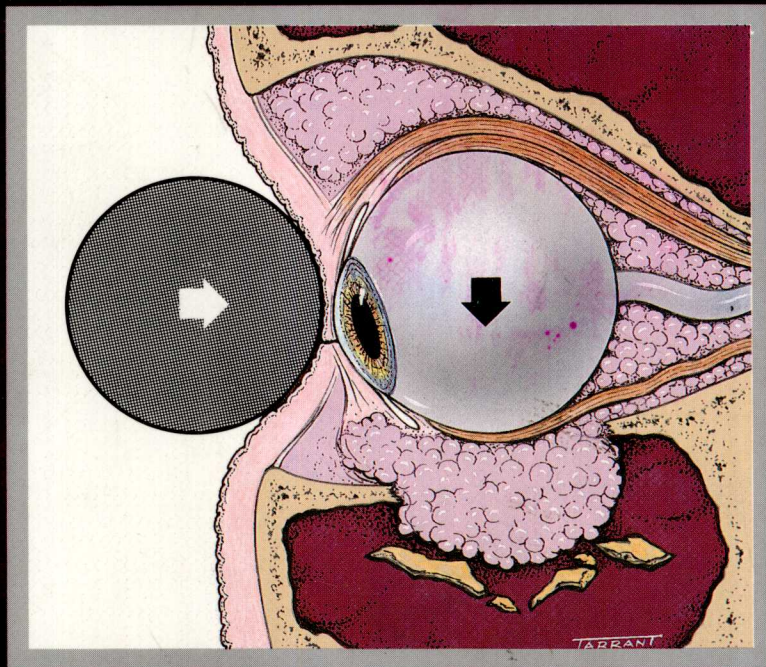

Immediate Eye Care



*N.K.Ragge
D.L.Easty*

IMMEDIATE EYE CARE

AN ILLUSTRATED MANUAL

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*with photographic assistance of Mrs Gill Bennerson
and watercolours by Mr Terry Tarrant*

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Foreword by Michael J. Roper-Hall

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Foreword

It gives me much pleasure to write a Foreword to this book which provides for those whose needs lie somewhere between the medical student's and the fully trained ophthalmologist's. It contains current information expressed in a clear, concise and understandable manner.

The scope is much more comprehensive than the title suggests and a full range of ophthalmic conditions is included, with their recognition and management. There is much recent information which establishes a substantial basis of knowledge for those beginning a study of ophthalmology, but this information is also needed by those whose aim is towards other branches of medicine. It should be used as a manual in clinical situations which present to all doctors involved in acute clinical care. These doctors have considerable responsibility for the recognition and early management of eye conditions, and yet many of them feel that their training is deficient in this field. Their burden will increase with the coming substantial changes in primary health care.

A publication such as this is a ready source of information and easy reference, assisted by its division of contents, the large number of illustrations and a good index. Its division into two distinct sections is useful. The first describes conditions affecting the individual tissues, and the second their wider associations. The high quality illustrations are particularly useful in the recognition of eye signs and help the reader to validate a provisional diagnosis. The adjacent text gives further confirmation and indicates the appropriate investigations and therapy. As far as possible the description, symptoms, signs, differential diagnosis and management of a particular condition are placed on the same page spread as the illustration.

There are numerous ophthalmic conditions which do not require immediate care and those are correctly given limited space. The brief outline description of the later management of these conditions expresses a conservative rather than a radical approach, especially in respect of surgery. Such an attitude is wise for those gaining experience and provides sound guidance which the readers should be cautious to modify.

Nicola Ragge has entered ophthalmology with enthusiasm and early success. She has had a sound basis in her earlier training in medical sciences and pathology, followed by experience in many paediatric subspecialties, intensive therapy and general emergency work. She has gained higher qualifications both in medicine and ophthalmic surgery and has taken up a Fellowship in Paediatric and Neuro-ophthalmology supported with the award of the Keeler scholarship by the College of Ophthalmologists.

David Easty is an authority on many aspects of external eye disease and is highly respected for his many contributions to clinical ophthalmology, both before and after his appointment to the Chair of Ophthalmology in the University of Bristol. He is frequently invited to speak at ophthalmic society meetings and teaching courses. The combination of the talents of these two authors is admirably suited to the preparation of this book and should make it particularly useful to the intended readers. The authors have had the advantage of an abundant source of clinical material and willing co-operation from many colleagues, who have provided illustrations which greatly enhance the usefulness of the book.

The detailed explanatory text goes further than merely assisting in diagnosis, providing a source of reference and guidance. The immediate management is clearly set out and an indication given of which conditions need to be referred, the degree of urgency and to whom the referral should be made. The key coding will be particularly helpful in this respect. Suggestions for further reading are helpful in finding sources of more information. These will be important to those whose interest is stimulated to seek further knowledge in this attractive and increasingly important speciality.

M.J. Roper-Hall
Birmingham

Preface

Doctors often find it difficult to diagnose and manage eye disease. This is unfortunate because the prevalence is high. The fear of blindness, which may be allayed eventually, but only after clinical examination, impels patients to seek an immediate opinion. Some patients will indeed need treatment, others referral to an expert, while many will just require reassurance. It is the responsibility of the general practitioner and casualty officer to make these decisions.

There appear to be a number of reasons why medical graduates worry about their patients with eye disease. Firstly, ophthalmology is not taught effectively because, despite the enthusiasm of university departments, the teaching time allocated to the speciality is regrettably short. The emphasis of the content is rather theoretical and the students have limited time to develop their practical skills.

There are other reasons. The anatomy of the eye and orbit is complex and quickly forgotten. The eye itself is miniature and requires special methods of examination. Many of the diseases are specific to the eye and have their own peculiar nomenclature. Most health centres and casualty departments are not equipped for the care of eye disease and even when the equipment is available, doctors are unfamiliar with its use.

The aim of this book is to provide an illustrated text and atlas for general and family practitioners, hospital casualty officers and emergency physicians, eye hospital casualty departments and ophthalmologists in their initial training. It is a book that medical students will find helpful and interesting in their undergraduate years and in their subsequent careers.

The book sets out to cover all the diseases of the eye which may require an immediate opinion, although experience shows that urgent action is not always necessary. The first half contains a systematic approach to disorders of the eye with each part of the eye described in separate chapters. The second half builds upon this initial section, covering topics of special interest such as tropical eye disease, industrial eye disease, paediatric ophthalmology and drug effects on the eye. Since there is a need for donor corneas for transplantation, a section on eye removal is included.

The book is designed as a manual to be used in the acute clinical situation. Each topic is sub-divided into a short description, symptoms, signs, differential diagnosis and management. The advice on treatment is organised to indicate what degree of therapeutic responsibility can be taken and when referral, urgent or otherwise, must be made. Coded recommendations of levels of care and when to refer are provided to speed and focus the reader on the treatment which they could provide (see Key). Simple therapeutic procedures are shown step-by-step and, where possible, exact dosages of drugs are given. The approach is necessarily didactic, providing a selected method of treatment, although others may be acceptable.

It is hoped that this illustrated guide to immediate eye care will achieve its aims of improving the confidence of medical students and doctors who read it to deal with eye disease, and of heightening their awareness of, and interest in, this vital speciality of medicine.

Key

- Ⓟ Family Practitioner and Casualty Officer or Emergency Physician
- Ⓡ Eye Casualty Officer or Resident in Ophthalmology
- Ⓢ Ophthalmologist or Specialist

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The authors are grateful to many people for their assistance in preparing this book. In particular we are indebted to Mrs Gill Bennerson for her photographic assistance, Mr Terry Tarrant for his magnificent artwork, Mr Rob Ellis for preparing many of the line diagrams, Mr Patrick Delarue for his photographs of ophthalmic equipment and Dr Juan Salinas for providing the Glossary. We should like to thank the consultants at the Bristol Eye Hospital for allowing us to photograph their cases. Some of the photographs are kind donations from colleagues and we have endeavoured to acknowledge them individually under each photograph. We should like to thank Mr Christopher Dean Hart, as head of the Photographic Department, for allowing us to use some of the photographs from his collection. In addition, we would like to acknowledge with thanks photographs taken of cases at Moorfields Eye Hospital. Our thanks are also due to Sister Jane Fox and the rest of the staff of the Bristol Eye Hospital Casualty department for their cooperation and help with the cases. Many associates have given us assistance in specialist areas including Dr Gavin Goodman, Employment Medical Adviser, Health and Safety Executive (occupational eye disease) and Mr John Sandford-Smith (tropical eye disease). Our thanks are also due to those people who have offered us helpful criticism of the text, in particular Mr Frank Larkin and Dr Mandy Sharpe. Finally, we should like to thank Mr Jonathan Black, the first author's husband, for advice and support throughout the preparation of the book.

Glossary

Abduction — Outward rotation of one eye from the primary position

Aberration — Optical defect in which the rays from a point object do not form a perfect point image after passing through an optical system

AC/A Ratio — Accommodative convergence to accommodation ratio is the measure of accommodative convergence in prism dioptres for each dioptre of initiating accommodation

Accommodation — Ability to increase the convexity of the crystalline lens in order to obtain a clear image of a near object

Accommodative spasm — Spasm of the ciliary muscle

Addition, Near — The difference in spherical power between the distance and near corrections.

Abbreviated: add

Adduction — Inward rotation of one eye from the primary position

Amaurosis Fugax — Temporary visual loss similar to a descending curtain; fleeting blindness

Amblyopia — A condition characterised by low visual acuity which is not the result of any clinically demonstrable anomaly of the visual pathway, without any apparent lesion of the eye and which is not correctable by optical means

Ametropia — The ametropic eye has an abnormal type of refraction so that parallel rays of light entering the eye do not come to focus on the retina

Angiography, Fluorescein — A technique used for the examination of the retinal and choroidal circulation, facilitated by the intravenous injection of a fluorescent dye

Angle Kappa — Angle between the optical and the visual axis

Anisocoria — Pupils are of different size

Anisometropia — The refraction of the two eyes is different

Anterior Chamber — Space within the eye, bounded anteriorly by the cornea and posteriorly by the iris and lens

Aphakia — Absence of the crystalline lens. It may be congenital, but usually it is due to surgical removal of a cataract

Aqueous Flare — Scattering of light seen when a beam of light is directed into the anterior chamber, occurring as a result of increased protein content in aqueous humour

Aqueous Humour — Clear fluid formed within the processes of the ciliary body by filtration

Astigmatism — Refractive condition of the eye in which the refracting power is not uniform in all meridians

Asthenopia — Eyestrain, symptoms associated with the use of the eyes

B.d. — Twice a day

Binocular Vision — The ability to use both eyes simultaneously

Binocular Single Vision — The ability to use both eyes simultaneously so that each eye contributes to a common single perception

Biomicroscope — An instrument designed for detailed examination of the eye. Contains a magnifying system and a slit lamp

Break-up Time Test — Test for assessing the precorneal tear film stability

Canal, Schlemm's — Circular venous sinus located in the corneo-scleral junction

Canaliculi — Part of the lacrimal drainage system. Short vertical segments that begin at the puncta, turn through a right angle to form horizontal segments that fuse, and empty into the lacrimal sac

Canthus — Angle formed by the upper and lower eyelids at the nasal or temporal end

Cataract — Opacities in the crystalline lens that disturb vision

Central Fixation — The reception of the image of the fixation object by the fovea

Chalazion — Localised swelling of the lid due to blockage of the duct of a Meibomian gland

Chemosis — Severe oedema of the conjunctiva

Chromatopsia — Condition in which the objects appear falsely coloured

Coloboma — A portion of the structure of the eye is lacking, typically affecting the iris, choroid and retina or eyelid

Concomitance — The two eyes move as a unit, maintaining a constant angle between them for all directions of gaze

Concomitant Strabismus — The angle of deviation remains the same in all directions of gaze, whichever eye is fixing

Confusion — The simultaneous appreciation of two superimposed images owing to the stimulation of corresponding retinal points by two different images

Convergence — Movement of the eyes toward each other or inward

Cover Test – Test for determining the type of strabismus

Crossed Fixation – Either eye is used to fixate in the contralateral field

Crowding Phenomenon – Difficulty in discriminating small visual acuity tests when they are presented next to each other in a row, typically seen in amblyopia

Cycloplegia – Paralysis of the ciliary muscle resulting in a loss of accommodation, usually accompanied by dilatation of the pupil, due to the effect of a cycloplegic drug

Cycloplegic Occlusion – The embarrassment of vision by using a cycloplegic drug (as might be used in the treatment of childhood amblyopia)

Cup/Disc Ratio – The ratio of the vertical diameter of the physiological cup to the vertical diameter of the optic disc

Cyclitis – Inflammation of the ciliary body

Dacryoadenitis – Inflammation of the lacrimal gland

Dacryocystitis – Inflammation of the lacrimal sac

Dioptré – Unit of lens power. It is the reciprocal of the focal length of the lens in metres

Dioptré, Prism – A unit specifying the amount of deviation by an ophthalmic prism. A prism of one prism dioptré power produces a 1 cm linear apparent displacement of an object situated at 1 m

Diplopia – Double vision

Distichiasis – Double row of eyelashes in the lid margin, one row being normal and the other turning inward toward the eye

Divergence – Movement of the eyes outward

Drüsen – Colloid bodies, small, discrete, yellow-white, slightly elevated spots on the retina

Ductions – Rotary movements of one eye from the primary position

Ectasia, Corneal – A forward bulging of the cornea as in keratoconus

Ectopia Lentis – Dislocation of the lens relative to the pupil

Ectropion – Outward turning of the eyelid

Electro-oculography – Measures the standard action potential which exists between the cornea (positive) and the back of the eye electrically (negative)

Electroretinography – Record of an action potential produced by the retina when it is stimulated by light of adequate intensity

Emmetropia – Ideal refractive state of the eye, in which with accommodation relaxed, an object at infinity is focused on the retina (the conjugate focus of the retina is at infinity)

Entropion – Inversion of the eyelid

Enucleation – Removal of the eye from its socket

Epicanthus – A fold of skin partially covering the inner canthus

Esophoria – Inward turning of the eye from the active position when fusion is suspended

Esotropia – One or the other eye deviates nasally

Evisceration – Removal of contents of the eye as in endstage endophthalmitis

Exenteration – Removal of the eye and orbital clearance as seen in malignant conditions

Exophoria – Outward turning of the eye from the active position when fusion is suspended

Exophthalmos – Abnormal protrusion of the eyeball

Exotropia – One or the other eye deviates temporally

Focimeter – Lensometer. Optical instrument for determining the vertex power, axis direction and optical centre of an ophthalmic lens

Fusion – Sensory. Ability to perceive two similar images, one formed on each retina, and interpret them as one

Gaze Palsy – Loss of conjugate gaze which may affect horizontal or vertical versions

Glaucoma – Rise in the intraocular pressure that is associated with damage to the optic nerve head and visual field loss

Gonioscope – Instrument used to observe the angle of the anterior chamber

Guttata, Cornea – Dystrophy of the endothelial cells of the cornea

Heterochromia – Difference in colour of the two irises or of different parts of the same iris

Heterophoria – Both visual axes are directed toward the fixation point but deviate on dissociation

Heterotropia – One or other visual axis is not directed toward the fixation point

Hippus – Small rhythmic variations in the size of the pupils

Hypermetropia (Far Sight) – Refractive condition of the eye in which distant objects are focused behind the retina when the accommodation is relaxed

Hyperphoria (Hypophoria) – A vertical deviation occurring on dissociation in which one eye rotates upward and the other downward depending upon the fixation

Hyphaema – Haemorrhage into the anterior chamber

Hypopyon – Pus in the anterior chamber

Incomitant Strabismus – The angle of deviation differs depending upon the direction of gaze or according to which eye is fixing

Intraocular Lens Implant (IOL) – A lens inserted in the eye to replace the crystalline lens after cataract extraction

Intraocular Pressure – The pressure within the eyeball

Iridectomy – Surgical removal of part of the iris
Iridodonesis – Tremulous movements of the iris as seen in aphakia

Iris Bombé – Forward bulging of the iris due to an increase of aqueous humour in the posterior chamber

Keratic Precipitates – Cellular deposits on the corneal endothelium

Keratoconus – Thinning disorder of the central and paracentral cornea of unknown aetiology. The cornea bulges forward in a cone shaped fashion

Keratoglobus – Rare bilateral enlargement of the cornea in which it assumes a globular shape

Keratomalacia – Pathological changes in the cornea due to Vitamin A deficiency

Keratoplasty – Excision of corneal tissue and its replacement by a cornea from a human donor

Leukoma – Dense, white corneal opacity caused by scar tissue

Myopia (Near Sight) – Refractive error of the eye in which distant objects are focused in front of the retina when the accommodation is relaxed

Nystagmus – Repetitive oscillatory movement of one or both eyes

O.d. – Once a day

Ophthalmoplegia – Paralysis of the ocular muscles

Ophthalmitis, Sympathetic – Bilateral inflammation of the uveal tract which usually follows perforation of one eye

Orthophoria – Both visual axes are directed toward the fixation point and do not deviate on dissociation

Orthoptics – Study, diagnosis and non-operative treatment of anomalies of binocular vision, strabismus and monocular functional amblyopia

Pachometer – A device used to measure the corneal thickness

Papillitis – Inflammation of the optic nerve head

Papilloedema – Bilateral optic disc swelling, secondary to raised intracranial pressure

Penalisation – Treatment of amblyopia or eccentric fixation by optical reduction of form vision of the non-amblyopic eye at one or all distances of fixation

Perimetry – Determination of the visual field

Phacoemulsification – Removal of the lens by emulsifying and aspirating the contents of the lens with the use of a low frequency ultrasonic needle

Polycoria – Two or more pupils in one iris

Posterior Chamber – Space in the eye filled with aqueous humour and bounded by the posterior surface of the iris, the ciliary processes, the zonule and the anterior surface of the lens

Presbyopia – Refractive condition in which the accommodative ability of the eye becomes insufficient for satisfactory near vision

Proptosis – Exophthalmos

Ptosis – Drooping of the upper eyelid

Q.d.s. or q.i.d. – Four times a day

Retinal Detachment – Separation of the neuroretina from the retinal pigment epithelium by an accumulation of subretinal fluid

Retinoscopy – Determination of the refractive state of the eye by means of a retinoscope

Rubeosis Iridis – Neovascularisation of the iris

Saccade – Involuntary fast movement of the eyes usually to take up fixation or in response to command

Scotoma – Area of partial or complete blindness surrounded by normal visual field

Seclusio Pupillae – Adhesion of the entire pupillary margin of the iris to the capsule of the lens

Snellen Chart – Situated 6m from the patient, it is made up of letters of graduated sizes with the distance at which each size subtends an angle of 5' (minutes) indicated along the side of the chart

Symblepharon – Adhesion between the palpebral and bulbar conjunctiva

Synechia, Anterior – Adhesion of the iris to the cornea

Synechia, Posterior – Adhesion of the iris to the capsule of the lens

T.d.s. – Three times a day

Trabecular Meshwork – Connective tissue located at the angle of the anterior chamber in a meshwork pattern

Trichiasis – Inward misdirection of the lashes

Vergence – Movement of both eyes in opposite directions

Version – Rotary movements of both eyes from the primary position in the same direction

Vestibular Nystagmus – Resulting from stimulation of the labyrinth

Visual Acuity – Test of macular function determined with different charts. Capacity for seeing the details of an object distinctly

Vitreous Detachment – Posterior vitreous separation from the retina

Xerophthalmia – Extreme dryness of the conjunctiva and cornea due to failure of the secretory activity of the mucin-secreting goblet cells of the conjunctiva due to trauma, exposure or Vitamin A deficiency

Dedication

To Jonathan and Božana – our respective partners

1 Methodology

Basic optics of the eye

In order to understand the basic principles of optics, it is helpful to define a few terms.

Refraction of light is the change in direction of a ray of light when it passes from one medium to another of a different density. Snell's law relates the change in angle of incidence to the angle of refraction at the boundary of the two media to their refractive indices by the equation: $n_1/n_2 = \sin i / \sin r$, where n_1 is the refractive index of the first medium, n_2 is the refractive index of the second medium, i is the angle of incidence and r is the angle of refraction. Thus rays of light passing from a less dense medium, for example air, to a more dense medium, for example cornea, will be deviated towards the normal. The effect of multiple rays of light being refracted in the eye is to focus the light on the retina.

Reflection of light occurs when light waves strike a smooth surface and bounce off rather than pass through. Some reflection occurs at the corneal surface as seen when a pen-torch is shone towards the eye.

Rays of light from an object of interest are refracted firstly by the cornea and then by the lens to become focused on the retina. The aqueous and vitreous humour provide clear optical media, but do not them-

selves contribute to the focusing power. The cornea provides two-thirds of the refracting power of the eye owing to the large difference in index of refraction between air (1.0) and cornea (1.376). The power of refraction is measured in dioptres (D) and the cornea contributes 43D to the refracting power of the eye. The lens provides the remaining power of refraction. It is a more powerful refracting surface in air, but is surrounded by aqueous which reduces its refracting power in the eye to 20D. During accommodation, contraction of the ciliary muscle relaxes the zonule fibres surrounding the lens thus allowing the lens to adopt a more spherical shape, increasing its refracting power for close objects. The combined refracting power of the eye is 58.6D (not a simple sum of the 2 refracting surfaces because they are separated in the eye).

The pupil is an important component of the optical system, acting as an aperture. When the pupil is small, chromatic and spherical aberration are reduced by allowing only paraxial rays through. In addition, the depth of focus is increased. In conditions of dim illumination the pupil enlarges allowing more light into the optical system.

Refractive errors and their correction

Refractive errors are the most common cause of loss of visual acuity. A pin-hole acuity helps to eliminate much of the loss due to refractive error (see p. 14).

Emmetropia is the ideal refractive state of the eye, in which, with accommodation relaxed, parallel rays of light, from an object at least 6m away, are focused at the plane of the retina.

Ametropia is any refractive state of the eye that is not emmetropia. It may occur because the optical elements of the eye are weaker or stronger than normal (refractive ametropia) or because the eyeball is larger or smaller than normal (axial ametropia).

Hypermetropia (far-sightedness) is the condition whereby the focused image is formed in a plane

behind the retina; i.e. the eyeball is too small or the optical elements too weak. In mild cases, this may be corrected by accommodation before the onset of presbyopia, when this ability is reduced. Constant accommodation to correct for hypermetropia may cause symptoms of tiredness and headache. In children, similar accommodation may be one of the causes of convergent strabismus due to the close relationship between accommodation and convergence. Hypermetropia is corrected with a convex (plus) lens in the spectacles. The correction required is stated in dioptres, for example Right Eye +3.00DS, where D refers to dioptres and S refers to spherical (that is non-astigmatic) correction.

Myopia (near-sightedness) is the condition whereby the focused image is formed in a plane in front of the retina; i.e. the eyeball is too large or the optical elements are too strong. High myopia is associated with a greater incidence of retinal detachment and also chorioretinal degeneration which may involve the macula.

Myopia is corrected with a concave (minus) lens. Thus a typical correction in a low myope might be: R. eye -2.50DS , L. eye -3.00DS .

Astigmatism is the condition in which the refracting power is not uniform in all meridians. Minor astigmatism is extremely common in the general population and if necessary is corrected with spectacles or contact lenses. Greater degrees of astigmatism may be associated with corneal irregularity as seen, for example, in keratoconus (see p. 102). Treatment with a hard contact lens is often of benefit here.

Astigmatism is corrected with a cylindrical (toric) lens that has no power in one meridian and maximum power in the meridian usually at 90° to this. It is often necessary to combine spherical and cylindrical lenses for optical correction when a prescription might read: R. eye $+3.50\text{DS}/-1.00\text{DC} \times 175^\circ$, where the spherical correction is $+3.50\text{D}$ and the cylindrical correction is -1.00D axis (of no power) 175° .

Aphakia is absence of the crystalline lens, usually as a result of surgical removal of a cataract. Here the refracting power of the eye is greatly reduced leading to refractive hypermetropia. Occasionally in high myopes, removal of the lens may bring the subject close to emmetropia. Correction of aphakia with spectacles produces a magnified image that may be difficult to fuse with that coming from the other

(phakic) eye. In addition, since high-powered lenses are often needed to correct the vision in aphakia, distortion of images may occur, leading to considerable difficulty in adapting to the spectacles. For these reasons, a contact lens is often preferable.

Presbyopia is the refractive condition in which the accommodative ability of the eye becomes insufficient for satisfactory near vision. It often starts around the fifth decade in emmetropes, but tends to occur earlier in hypermetropes who require more accommodation, and later in myopes who require little or no accommodation. It is corrected either by using two pairs of spectacles, one for distance and one for reading vision, or by using bifocal spectacles. In bifocals, a lens usually $+2.50$ – 3.00D , over and above the standard spectacle correction is incorporated in a lower or reading segment. Alternatively, trifocals or a graduated lens may be used to avoid the sudden division between near and distance vision.

Refraction is the name used to describe various testing methods to measure refractive errors of the eye. These methods include:

- retinoscopy, where a light reflected from the patient's retina is viewed as an illumination at the pupil and movement of this light is neutralised by concave or convex lenses placed in front of the eye as appropriate
- subjective refraction when lenses are placed systematically before the eyes until the best corrected visual acuity is reached
- automated refraction, which is a fast, sophisticated, if expensive approach.

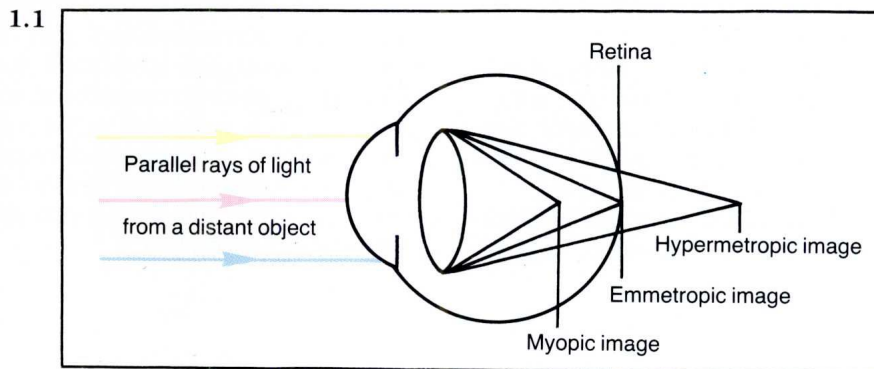


Fig. 1.1 Refraction of the eye in hypermetropia, emmetropia and myopia

History

- Ⓟ An ophthalmic history includes details of the presenting complaint, past ocular history, family history of ocular disease including glaucoma, cataract, macular disease and inherited disorders, general health and past medi-

cal history, especially diabetes, hypertension and cardiovascular disease, medications, allergies, smoking and alcohol intake, and social circumstances, including occupation.

Examination

Visual acuity

Visual acuity records the minimum angle subtended at the eye required to resolve two images. It is a test of the visual system from cornea to cortex. It requires patient cooperation and comprehension, clear ocular media, correct focusing, convergence, good retinal function, intact visual pathways and occipital cortex, and the ability to recognise the forms displayed. When all of these functions are intact it is a good test of macular function. Distance vision tests require no accommodation, thus presbyopia does not diminish distance acuity.

The Snellen chart (Fig. 1.2(a)) is most commonly used. Each letter height subtends 5' (1' is equal to $\frac{1}{60}^\circ$) of arc at a given distance from the eye and each part of the letter, e.g. the arm on an "E", subtends 1' (Fig. 1.2(b)). The distance at which a person with normal vision is able to stand away from the chart to see a particular letter is recorded under each line. The test is carried out at 6m or, if the space is not avail-

able, by using a special chart for 3m or a reversible 6m chart situated behind the patient's head with a mirror placed at 3m. The patient covers one eye at a time and his acuity is tested first without, then with spectacles and then looking through a pinhole if necessary.

Recording visual acuity: A person with normal visual acuity will be able to read the 6m line at 6m. This is recorded as 6/6 vision (or 20/20 vision in imperial units). Thus, the numerator is the distance of the patient from the chart and the denominator is the lowest line read. If only the top letter is seen, which can be read normally at 60m, the visual acuity is recorded as 6/60 (20/200) and so on. If the top letter cannot be seen at 6m the patient is brought closer to the chart until it can be identified. The distance of the patient from the chart, e.g. 3m becomes the numerator and the visual acuity is therefore 3/60.

1.2(a)



Fig. 1.2(a) Snellen chart

1.2(b)



Fig. 1.2(b) Diagram of an 'E' demonstrating that each arm subtends 1' and the whole 'E' subtends 5' at the retina

Use of pinhole: If the monocular visual acuity is worse than 6/12 a pinhole is used (Figs. 1.3 & 1.4). This corrects any refractive error. If, however, there is a very large refractive error, for instance in aphakia, it will only be partially corrected. It is especially useful if the patient has never had a refraction test or has left his spectacles at home. The new visual acuity is recorded as, e.g. 6/18 U/A (unaided), 6/9 with pinhole. If the pinhole does not improve vision, this is recorded as PHNH (pinhole no help).

Vision less than 1/60: If the top letter cannot be seen at 1 m, the vision is tested for the ability to **count fingers (CF)** (usually at 1 m), to see hand movements or to perceive light. If there is **perception of light (PL)** only, it is useful to record if there is **projection**, that is, if the patient can determine which quadrant the light is coming from. This is recorded as '+' if present, in each of the four quadrants, and is an indication of retinal function in the presence of dense, medial opacity preventing light reaching the retina. If there is **no perception of light** this is recorded as **NPL**.

Other tests of acuity include the **Landholt broken ring test**, where the position of the gap is identified, and the **Illiterate E test** (Fig. 1.5), where a cut-out letter E is orientated by the patient in the direction of the E indicated on the chart by the examiner. These tests are useful in patients who are unable to read and can be used in children after the age of 3 years.

Tests used in children: The **Catford Drum**

(Figs. 1.6(a) & (b)) consists of a drum with a range of different sized dots on it that is rotated in front of the infant. If the infant can see the particular dot size, his or her eyes will be seen to follow the target. The visual acuity scores obtained by this method are a rough guide only. A more accurate test of visual acuity is **preferential looking** (Fig. 1.7), where the infant or young child is presented with a series of gratings adjacent to similar sized, plain patches (controls) and the eyes are seen to move towards the patterned side. Thus, the visual acuity is measured by the finest grating size that is reliably discerned. This method of testing appears to be more accurate, but is not yet widely available. Stycar rolling balls are also used in basic assessment of visual acuity, e.g. by health visitors. **Kay picture tests** are used in the 18 month to 3 year age-group and are based on ability to identify pictures. **Sheridan-Gardiner cards** (Figs. 1.8(a) & (b)) may be used in the 3–5 year age-group. Here the examiner stands at 6 m and holds up different sized letters in turn. The child is asked to select that letter from a number of letters on the card he is holding. The visual acuity is recorded as for the Snellen chart.

Tests of near vision: Books are available with print of different sizes to test reading ability. This is usually recorded as N or J numbers. In the population aged over 45 years it is important to consider presbyopia as a cause for decreased near visual acuity especially if the distance visual acuity is normal.

1.3

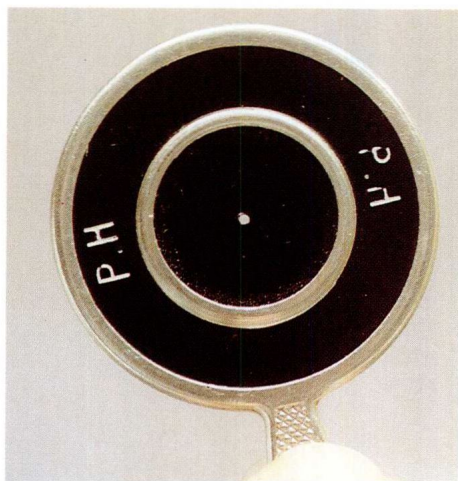


Fig. 1.3 Pinhole

1.4



Fig. 1.4 Pinhole in use