Current Practice

CHILD CARE IN GENERAL PRACTICE

Eye Disease in Children

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In this brief survey of modern trends in the treatment of eye disease in children four topics are discussed—squint, congenital stenosis of the naso-lacrimal duct, buphthalmos, and the management of the blind child.

Squint

A squint is a condition in which there is a failure of the visual axis (the line which passes from the central part of the retina, the fovea, to the object of fixation) of one eye (the squinting eye) to be directed at the same time to the object which is being fixed by the other eye (the fixing or non-squinting eye).

The various types of squint are designated by the following terms:

1. Manifest (heterotropic) when the squint is present constantly; intermittent when it is present only on certain distances of gaze—for example, the convergent squint which is present only on near fixation; and latent (heterophoric) when it is present only under conditions of stress.

2. Concomitant when the angle of the squint is the same irrespective of which eye is used for fixation; and incomitant when the angle of the squint is greater during fixation with the affected eye. This implies the presence of a paretic element.

3. Right or left when under normal conditions only one eye squints; or alternating when either eye squints in turn or indiscriminately.

4. Convergent when the squinting eye turns in (esophoria or esotropia); divergent when it turns out (exophoria or exotropia); sursumvergent when it turns up (hyperphoria or hypertropia); or deorsumvergent when it turns down (hypophoria or hypotropia) during the fixation of the non-squinting eye.

Development

A squint occurs as the result of a failure in the development of the binocular reflexes, as in the congenital and infantile forms of squint, or as the result of a disruption of the binocular reflexes during or even after their establishment. These reflexes are concerned with the phenomenon of binocular vision whereby the separate images which are seen by each eye (unocular vision) are appreciated as a single image (binocular vision). This achievement demands a proper co-ordination of many different and complex structural, motor, visual, and proprioceptive mechanisms during the early years of life because this form of vision is a gradually acquired characteristic, not an inborn one. Binocular vision is possible in man because of the

straight-ahead positions of the eyes, so that there is an overlap of the greater part of the visual field of each eye (the binocular field of vision). Any object in this field stimulates retinal elements in each eye which "correspond" physiologically with one another. In this way an object is viewed binocularly by a perceptual process of fusion in the higher visual centres as though from a "median eye" (binoculus) (Fig. 1).

FIG. 1.—Objects in the binocular field of vision stimulate retinal receptors in each eye which correspond with one another (A_1 and A_2 , B_1 and B_2 , F_1 and F_2) so that they are viewed from the binoculus by a process of fusion.

Adaptations

The development of squint is followed by various adaptations which are induced by the awareness of diplopia (the stimulation of non-corresponding retinal points in the two eyes by one object) and by the occurrence of confusion (the stimulation of corresponding retinal points in the two eyes by two different objects) (Fig. 2). In the young child, of course, this "awareness" is largely subconscious.

Suppression.—The vision of the squinting eye is suppressed by an active neglect of the eye by the visual cortex. This may be purely a temporary phenomenon which is transferred from one eye to the other as in the alternating forms of squint, but in the unocular squint it becomes permanent, so that true amblyopia develops in the squinting eye.

Eccentric Fixation.—Under normal conditions each retinal receptor has a distinct projection into space with the fovea as the point of straight-ahead projection, but sometimes in a unocular form of squint, particularly when it occurs at an early age and when there is a prolonged interval before the start of effective treatment, a point in the retina other than the fovea

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assumes the projection of the fovea and becomes a point of eccentric retinal fixation.

Abnormal Retinal Correspondence.—When the brain attempts to use the two eyes in association with one another despite the presence of a manifest squint the retinal elements develop an abnormal type of correspondence.

FIG. 2.—Diplopia is the result of a stimulation of non-corresponding retinal points (F_1 and A_2) by one object (X), and confusion is the result of a stimulation of corresponding retinal points (F_1 and F_2) by two different objects (X and Y).

Assessment

This is achieved by different methods of examination.

Corneal Reflexes.—A squint may be detected by regarding the positions of the reflexes which are visible on the cornea of each eye when a light is shone on the eyes. These reflexes lie in identical parts of the corneas in the absence of a squint, but the reflex in the squinting eye is displaced towards the outer side of the cornea in a convergent squint, towards the inner side of the cornea in a divergent squint, towards the lower side of the cornea in a sursumvergent squint, and so on. This is not a wholly reliable test but it is of value in determining the false appearance of a squint in certain cases, such as the apparent convergent squint when a child has a broad flat base to the nose in conjunction with well-marked epicanthic folds.

Cover Test.—This test consists of rapidly covering each eye in turn with the hand during the fixation by the other eye of a distinct target, such as a pen-torch light. In the absence of any squint there is no movement of either eye during the test, but in the presence of a convergent squint the eye which becomes uncovered moves outwards to the mid-line to take up fixation; in the presence of a divergent squint it moves inwards; in the presence of a sursumvergent squint it moves downwards, and so on. The test is of value also in the latent forms of squint because by dissociating the eyes it reveals the latent deviation. In such cases the removal of the hand from the eyes at the end of the test allows the eyes to recover to a binocular position, and the speed of recovery of the previously covered eye is a measure of the strength of the binocular reflexes. In manifest and latent squints the cover test should be carried out for near ($\frac{1}{3}$ metre) and distant (6 metres) fixations because in certain cases there is a marked difference in the extent of the deviations at these two points of fixation. The cover test is also of value in determining the presence of an incomitant element in the squint because of the greater deviation of the unaffected eye on enforced fixation of the affected (paretic) eye.

Ocular Movements.—The range of movements of each eye separately (duction movements) and of the two eyes together (version movements and vergence movements) should be carried out in order to detect any limitation of ocular mobility, and the nature of this is determined by an understanding of the actions of the six extrinsic ocular muscles (Fig. 3).

Head Posture.—The adoption of an abnormal head posture involving a turning of the face and sometimes also a tilting of the head is an indication usually of a vertical type of squint.

FIG. 3.—The actions of the extrinsic ocular muscles: lateral rectus (abduction), medial rectus (adduction), superior rectus (elevation, intorsion, and adduction), inferior rectus (depression, extorsion, and abduction), superior oblique (depression, intorsion, and abduction), and inferior oblique (elevation, extorsion, and abduction). The right and left orbits are viewed in cross-section from above, and the direction of pull of each muscle is shown by the arrow.

Retinal Fixation.—In any squint it is important to determine whether the fixation of the squinting eye is central (steady or unsteady), eccentric (steady or unsteady), or wandering. A careful cover test may reveal an eccentric type of fixation but an accurate assessment of fixation demands the use of a visuscope (a special type of ophthalmoscope which incorporates a fixation target in the centre of the field) in order to detect the exact nature of the fixation.

Health of Each Eye.—It is essential to ascertain that the squint is not due to some organic lesion affecting the visual function of the squinting eye—for example, a corneal opacity, a cataract, a retinoblastoma, a focus of macular choroidoretinitis, or some lesion of the afferent visual pathways like a craniopharyngioma.

Treatment

This involves a combination of several different methods in an attempt to secure a restoration of binocular function. There should be a sense of urgency about this treatment, particularly when the squint occurs at an early age; there is no place for a "wait and see" policy.

Glasses.—The provision of spectacles is an important aspect of the treatment of most cases of squint, except usually in the congenital or infantile cases. Young children as a general rule have a hypermetropic type of refractive error so that an effort of accommodation is required to enable a distant object to be seen clearly and an excessive effort of accommodation is required for a near object. This is liable to be associated with an excessive convergence because of the close accommodation-convergence relationship, thus favouring the development of a convergent squint. Conversely myopia may lead to a divergent squint. It is essential, however, to re-examine each case carefully shortly after the use of glasses because a mere reduction

in the angle of the squint by the glasses, though often pleasing to the parents of the child, is of no value in preventing the occurrence of complications unless the glasses control the squint sufficiently to permit a restoration of binocular function.

Occlusion.—In the younger child amblyopia is assumed to be present in the squinting eye when the squint is of the manifest type and when it is confined to one eye, but in the older child it is determined accurately by the use of Snellen's test letters or figures or by the use of the simple "E" test. In this test the child holds a large cut-out letter E in his hands and places the E in different directions to correspond with an E which is controlled by the observer.

Amblyopia is treated by occlusion of the fixing eye, usually totally for a sufficiently long period, weeks or even months, in order to restore the cortical appreciation of the squinting eye, but this is successful only if the fixation of the squinting eye has remained central. If the fixation of the squinting eye is eccentric the occlusion should be applied to the squinting eye (the so-called inverse occlusion) in the hope of achieving a disappearance of the eccentric fixation simply by preventing the abnormal impulses of the squinting eye from reaching the brain. Sometimes, if the fixation is unsteady it may be advisable to have a short period of conventional occlusion of the fixing eye but a careful re-assessment of the fixation is essential a few days later to determine whether the fixation has become central or eccentric. It follows that the application of occlusion in squint therapy is of great importance and demands the close supervision of a skilled observer.

Orthoptic Methods.—This treatment is carried out by an orthoptist, a medical auxiliary working in conjunction with an ophthalmic surgeon, who is concerned in the general management of the squint, in the supervision of occlusion therapy, and in the re-establishment or in the maintenance of binocular vision. This is achieved by the use of various instruments which involve the principles of the stereoscope, so that the fovea of each eye is presented simultaneously with the images of objects which may be associated with one another in the brain after an appropriate adjustment to compensate for the angle of squint. The orthoptist is also concerned in the more recent methods of pleoptic treatment, which involve the re-education of the fixation of the squinting eye by the creation of after-images which are projected into space. Unfortunately this elaborate treatment is time-consuming and is applicable only to children over the age of 6 years because of the concentration and co-operation which it demands of the child.

Surgical Correction.—The surgical correction of the ocular deviation is the logical stage in the treatment of the squint after the restoration of vision in the squinting eye. This carefully planned treatment is carried out on one, two, or even more of the eye muscles of one eye, or sometimes both eyes, at the same or different time. Children tolerate this operation very well; the child leaves his bed for the operating theatre in a relaxed state because of the use of modern sedatives, the operation is performed under general anaesthesia, and the eyes are covered for only a few hours or often not at all.

Congenital Stenosis of Naso-lacrimal Duct

The tears which accumulate in the lacrimal sac are expelled into the inferior meatus of the nose through the naso-lacrimal duct, which is lined by a mucous membrane in continuity with the mucous membrane of the lacrimal sac and nose. The duct is formed shortly before birth by a central canalization of a solid cord of cells, but sometimes this breakdown of cells is incomplete or some of the cellular detritus may become obstructed in the duct so that part of the duct remains stenosed, a condition which fosters the occurrence of infection within the tear sac. Subsequent inflammatory changes in the mucous membrane of the duct increase the extent of the block and favour the develop-

ment of a permanent fibrosis. The condition may be unilateral or bilateral.

Treatment

The first aim of treatment is to relieve the infective element by the frequent use of antibiotic drops (penicillin 5,000 units per ml., chloromycetin $\frac{1}{2}\%$, etc.). In many cases this may be sufficient to permit the final canalization of the duct, a process which may be helped by frequent pressure over the lacrimal sac (immediately behind the anterior lacrimal crest) in the hope of expressing the contents of the sac down the duct. If, however, the obstruction persists it is necessary to pass a probe along the whole extent of the naso-lacrimal duct by an approach through the upper or lower canaliculus and the lacrimal sac. It is usually wise to delay this probing until the age of 6 months because of the chance of a spontaneous cure, but it should not be delayed beyond the age of 12 months otherwise the effect of the probing may be only temporary. The operation is carried out under a short general anaesthetic.

Buphthalmos (Infantile Glaucoma)

This form of glaucoma is the result of a developmental anomaly of the tissues of the filtration angle so that the aqueous humour is impeded in its exit from the anterior chamber. It usually involves both eyes but often to varying extents. The condition presents as a progressive enlargement of the eye because the immature outer coat of the eye (cornea and sclera) is unable to withstand the increased intra-ocular pressure, so that the affected eye usually becomes myopic. It follows that any case of advancing myopia in early childhood (a rare event) demands the careful exclusion of any buphthalmic element. This may necessitate a measurement of the intra-ocular pressure under a general anaesthetic. The cornea may remain relatively clear for some time but eventually it becomes hazy as the result of oedematous changes in the epithelium and in the stroma, sometimes in association with considerable redness of the eye and photophobia. The increased intra-ocular pressure also affects the optic nerve-head with the development of atrophic changes so that there is a progressive loss of vision leading to eventual blindness in the absence of effective treatment.

Treatment

Buphthalmos seldom responds to medical treatment, though prostigmine 3% drops and the administration of acetazolamide (Diamox) are useful temporary measures. The most effective operation is a goniotomy, which consists of stripping away the abnormal tissues from part of the filtration angle with a special knife which is passed across the anterior chamber into the angle under direct view through a gonioscopic lens on the surface of the cornea. Thereafter the eyes should be re-examined at repeated intervals and if necessary a further goniotomy may be carried out.

The Blind Child

The definition of blindness in a child is related essentially to the educational methods which are going to be necessary for his upbringing, so that the blind child is one who is dependent on a form of education which does not involve the use of sight. In the first two years of life the blind child is to some extent the concern of the welfare department of the local authority, which authorizes a qualified health visitor to supervise him in his own home, but it is generally recognized that during the early and formative years there is nothing to replace an upbringing within the family. The brunt of the responsibility for his initial progress is therefore imposed quite rightly on the parents, and in ideal circumstances he continues at home until

his fifth birthday. He is then placed in a residential primary school for blind children where particular stress is laid on the learning of Braille, but sometimes he may go first to a Sunshine Home until his seventh birthday. In certain circumstances he may start at a Sunshine Home any time after his third birthday. Thereafter the blind child proceeds to the Royal Normal College

for further education or, when sufficiently gifted, to a special grammar school and subsequently to a university.

I would like to thank the National Society of Children's Nurses for permission to reproduce Figs. 2 and 3 which I used in the booklet *The Eyes in the Early Years of Life*.

ANY QUESTIONS?

We publish below a selection of questions and answers of general interest.

Blood Transfusion for CO Poisoning

Q.—Is whole-blood transfusion of any value in cases of carbon-monoxide poisoning?

A.—The toxic effect of carbon monoxide is mainly due to its interfering with the respiratory function of the blood by displacing oxygen from combination with haemoglobin. This process is reversed by breathing 100% oxygen, which leads to elimination of half the carbon monoxide in about 30 minutes.

The quantity of CO-free haemoglobin is also increased by transfusion of whole blood. For example, in a patient with a blood volume of 5 litres whose blood is 50% saturated with carbon monoxide the transfusion of 2 pints (1.1 litres) of blood will lower the saturation of CO Hb to 42%. Thus on theoretical grounds the procedure should be of value in the treatment of carbon-monoxide poisoning. But it is irrelevant since the effect is small and the procedure is both slow and may precipitate cardiac failure if the myocardium is damaged by hypoxia.

Patients breathing spontaneously who do not respond to standard treatment with carbogen or 100% oxygen at ambient pressure may, if facilities are available, derive benefit from hyperbaric oxygen therapy. In addition, treatment may be required for the complications of carbon-monoxide poisoning, including cardiac or respiratory arrest, cerebral oedema, and circulatory collapse. However, the measures to be taken do not include the transfusion of whole blood, which is therefore of no practical use for either CO poisoning or its complications.

Treatment of Scabies

Q.—Is 6% dicophane cream an effective and safe treatment for scabies in patients who object to the smell of benzyl-benzoate emulsion? How many times a day and for how many days should it be applied?

A.—For the effective treatment of scabies it is essential to treat the entire skin from the neck downwards with an application that is lethal to the *Acarus scabiei* without any significant toxic effect to the patient. A 20–25% emulsion of benzyl-benzoate will cure scabies after a single thorough application without any significant discomfort or risk from toxicity. Its smell is neither offensive nor noticed after the emulsion has dried on the skin. If necessary the smell can easily be disguised by suitable additives.

Dicophane (D.D.T.) has not been found to be an effective application in scabies. Resistance to D.D.T. is commonly found in

mites and ticks. During the latter part of the last war the U.S. armed Forces used as an "all-purpose" treatment against lice and scabies an application which, when diluted as directed, contained 1% D.D.T., 2% benzocaine, and 10% benzyl-benzoate. This preparation seemed to have been much more effective against lice than scabies, and frequently repeated applications produced irritant and sensitivity reactions.

D.D.T. is certainly more toxic than benzyl-benzoate, and the application of a cream to the whole body from the neck downwards is more difficult and time-consuming than applying benzyl-benzoate emulsion with a paint brush. A useful alternative treatment would be 0.5% to 1% hexachloride cream or lotion containing the gamma isomer of benzene hexachloride (Gammexane). It is almost odourless.

Prognosis for Myopic Child

Q.—Is there any correlation between prognosis for a myopic child and his resemblance to his myopic parent so far as external ocular features go—colour, shape of eyes, etc.?

A.—Presumably the questioner has in mind a case where the parent has degenerative myopia and the child shows refractive changes only, and the problem is to decide whether the child is likely to develop degenerative changes later in life. In such a case I do not think the colour of the iris is of much help, and the only prognostic evidence of value is the rate of change of refraction in the child and the onset of early signs of degenerative changes.

Stapedectomy for Otosclerosis

Q.—In what cases of otosclerosis is stapedectomy considered the treatment of choice? How successful is the operation?

A.—When deafness is due to otosclerosis stapedectomy is the treatment of choice.¹ In this operation, which is done through the ear canal, the ear drum is turned forward, the head and crura of the stapes broken away, and a hole is picked in the footplate of the stapes sufficiently large to allow a Teflon piston 0.6 mm. in diameter and 4.5 mm. long to be passed just through the hole in the footplate of the stapes. The outer end of the piston is shaped like a split ring, which is opened and then passed over the long process of the incus, which it embraces.

When there is a good air–bone gap and the bone conduction is good, then, in expert

hands, the chance of a long-term improvement in hearing is 85%. There is a small chance of not more than 2% that the hearing in the operated ear may be made worse by the operation, and in a total of about 7% the hearing improvement may slowly fade during the two to three years after the operation. But, even so, finally the patient is left with an 85% chance of a long-term improvement in hearing.

The operation is even suitable in very advanced cases of otosclerosis where there is hardly any hearing by air conduction at all. The least favourable cases are those in which the otosclerosis has started before the age of 20, and whenever possible operation should be postponed until the patient has finished growing at about 25. The operation is not dangerous and there are rarely any complications.

REFERENCE

¹ *Brit. med. J.*, 1965, 1, 1081.

Effect of Reduced Lung Compliance

Q.—Would a reduction in lung compliance (as occurs, for example, in some cases of farmers' lung) result in a low forced-expiratory-volume reading?

A.—Pulmonary compliance measures the elasticity of the lung, and is reduced when the lungs are more rigid—for example, in mitral stenosis. In the case cited the forced expiratory volume after one second (F.E.V._{1.0}) would be reduced because of impairment of inspiration. The vital capacity would be at least proportionately reduced so that the ratio F.E.V._{1.0}/V.C. would be normal or higher than normal.

Vitamins D₂ and D₃

Q.—Has vitamin D₃ any therapeutic value over vitamin D₂ when given by injection in doses of 15 mg.? Is one more toxic than the other?

A.—In the present state of our knowledge there is no difference between the strength or mode of activity of vitamin D₂ and vitamin D₃. This applies to any preparation, whether given by mouth or by injection. Both preparations are available in doses of 15 mg. for intramuscular injection, and vitamin D₃ can also be obtained for intravenous injection. There is no special advantage in the injection if it can be given by mouth.

A dose of 15 mg. is very large and is certain to cause intoxication in a proportion of subjects if given repeatedly. Its main value is when given as a single injection as prophylaxis against classical rickets when family circumstances are difficult and suitable diet cannot be ensured. There is no known difference in toxicity between vitamins D₂ and D₃.