ABC of Ophthalmology

P A GARDINER

REFRACTIVE ANOMALIES

Disorders of shape and size

Refractive disorders are basically purely disorders of shape and size determined by inheritance and growth. Correct refraction depends on the distance between the cornea and the retina and its relation with the curvatures of both the cornea and the lens.

The three common disorders of refraction are hypermetropia (long sight), myopia (short sight), and astigmatism—which may exist on its own or in combination with either myopia or hypermetropia.

The long-sighted eye is too short from back to front, so that focused images cannot be focused on the retina but fall behind it. Conversely, the short-sighted eye is too long, and focused images from any distance may fall in front of the retina.

In any eye as an object comes closer its focused image within the eye moves further back. In short-sighted people there comes a point where it coincides with the retina: hence their ability to read without glasses, though they may be severely handicapped for distance vision.

The defect in hypermetropia is slightly different. Although the nearer an object comes to the eye the further backwards the image is focused, this backward movement may be completely or only partially neutralised by accommodation. Accommodation plays no essential part in myopia.

Accommodation: changing the curvature of the lens

Curvature of the lens is the only dimension in the eye over which there is commonly any control. Normally the eye is "set" for distance, but the lens can be squeezed by its controlling muscle (the ciliary muscle) to give greater magnification and accurate focusing for near work such as reading. This is known as accommodation. When the pressure is released the lens, being elastic, resumes its normal shape. The amount of adjustment that can be obtained through accommodation is limited, so small near objects for many people are impossible. The ability to accommodate is greatest in children and progressively diminishes. This loss of accommodating ability produces difficulties with reading in the early 40s and is complete by the early 60s. This is because the lens gradually loses its elasticity and hardens and explains why people with previously normal vision need reading glasses in middle age.

Astigmatism

To produce a clear image the surface of a lens must be evenly curved. In astigmatism the curvature of the cornea differs according to whether it is measured horizontally or vertically. An image reaching the retina is therefore focused differently in one axis from the other. The effect is rather like the image in a distorting mirror.

Astigmatism may be superimposed on short- or long-sighted eyes, or it may be the only optical defect.

Development in children

Myopia

- 1 Greater changes in childhood
- 2 Possibility of later degeneration of vitreous and retina

Normally changes in the curvature of the cornea and lens compensate for the effect of the increasing length of the eyeball that occurs during a child's growth. The notable exception is myopia. Children or adolescents who develop myopia not only have an eyeball longer than average but changes in the curvature of their cornea or lens are not adequate to compensate. Children rarely become myopic before the age of 6 (though a few are born myopic). The number of new cases increases from then on, reaching a peak at about 11.

The myopia usually gets intermittently worse until the late teens, when changes stop in most patients. This change is irreversible, and it is frequent enough in some children to warrant a change of glasses every six months. The unpredictability of the rate of change necessitates a review every six months or so.

Myopia seems to differ from hypermetropia in two respects. The changes in refraction during childhood and adolescence tend to be much greater in myopia than in hypermetropia, and a small percentage of myopic adults develop secondary degeneration of the retina and the vitreous, leading to a range of visual handicap in later life. These changes warrant an attitude of wariness towards myopia.

We do not know any way of preventing myopia, its progress, or its complications. The myopic child tends to be an achiever and should be given every encouragement to fulfil his potential.

Dealing with defects in refraction

For any anomaly of refraction the decision whether to prescribe glasses must be based on the individual's visual difficulties, not on the refraction alone. In adults the use or disuse of glasses for long sight or short sight has no long-term effect on changes in vision. But young children with marked refractive anomalies should wear glasses or they may never reach their full visual potential.

These optical abnormalities may be assessed by measuring the "refraction." The examiner flashes a light through varying lenses through the pupil to the back of the eye until an abnormality is neutralised. Theoretically this gives an absolute measurement of the abnormality and an accurate guide to the best prescription. But it does require some co-operation from the patient, so that children or confused people present difficulties.

The decision on the best glasses is not just a scientific one based on optical measurements but also a professional one based on an assessment of the person's need to see and how much he can tolerate. For example, some ophthalmologists use the bottom line on an eye chart as an example of intolerable visual detail for some people.

Since the presence of an optical defect is not a compelling criterion for prescribing compensating glasses, a middle-aged person who is slightly hypermetropic in one eye and slightly myopic in the other—that is, has optically imperfect eyes—can reasonably use his long-sighted eye for excellent distance vision and his short-sighted eye for minute reading vision. There are many other examples where glasses are unnecessary.

From this point of view, adults could well choose their own spectacles from a self-service store, but many serious visual disorders would be missed. For example, increasing myopia often occurs in people with incipient cataracts—changes in visual acuity should therefore always be investigated by specialists.

Common misconceptions

There is no known explanation for the breakdown in co-ordination of the growth of the eye that occurs in children with myopia, but there are several misconceptions. The commonest is that myopia is due to too much reading. There is no statistical evidence for this but it gains credibility because of the age at which myopia appears (that is, during school) and because of the correlation between myopia, social class, and academic achievement.

Both in the case of acquired myopia in children and in the other common acquired visual defect—presbyopia in middle age—people are inclined to confuse the fact that their vision tends to continue to deteriorate even after they have got spectacles with the thought that the spectacles cause the deterioration. Intrinsic changes in sight are not influenced by glasses at all, but in young children full visual potential may never be reached if glasses are not worn.

Another common fallacy is that eyestrain damages the eye. Use of the eye, even "excessive" use to the point of fatigue does not damage the eye, just as excessive physical exercise to the point of fatigue does not damage the legs. The brain, which has the job of interpreting the images, tires long before the eye can be harmed.

There is no proof that contact lenses have any effect on the changes that occur in myopia or any other refractive disorder. Because of their position on the eye a larger change in the basic myopia has to take place than with glasses before a visual loss is noticed.

In conditions such as conical cornea, other corneal dystrophies, and unilateral aphakia contact lenses are extremely valuable. Tolerance and length of wear achieved by different people vary greatly and are usually unpredictable at the outset. Injuries resulting from faulty manipulation can be painful and even disabling. To some extent these complications can be lessened by using the soft variety, but these do not give such good vision. They also demand stringent hygiene and introduce the danger of infection. People working in dusty, windy atmospheres or where smoke or fumes occur are not likely to find contact lenses comfortable. Similarly, those with hay fever or other allergies may have special difficulties.