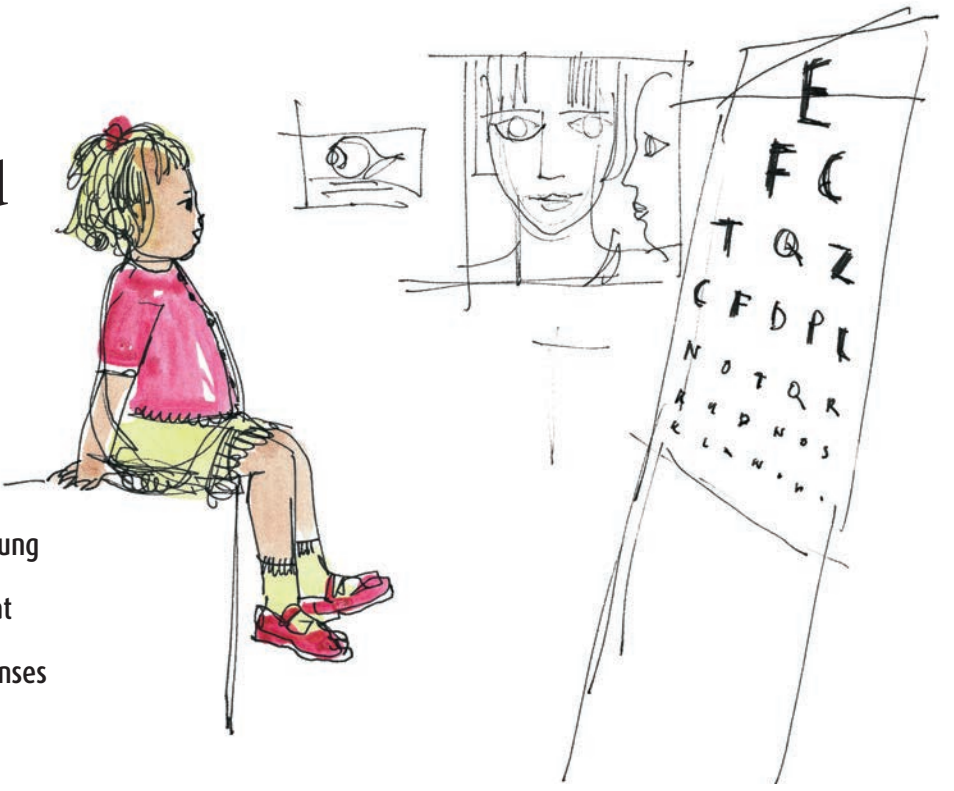
# Refractive errors in childhood and adolescence



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**Refractive errors are a significant cause of amblyopia in infants and young children, and may lead to problems at school in older children. Corrective lenses will be required in some cases.**

## Presentations

The signs and symptoms of refractive errors in children and adolescents are many and varied, and are said to include excessive blinking, frowning, eye rubbing, head tilting, closing of one eye, clumsiness, photophobia, red eye and epiphora (an excess of tears). In practice, however, these features are only rarely explained by refractive errors. In infants and younger children, the errors are most likely to present as a squint; in older children, they may cause problems at school, such as an inability to read a blackboard or visual fatigue on prolonged close work. Headaches in children are rarely caused by a refractive error unless there is a clear association between visual effort and the onset of the headache.

The types of refractive errors that are seen in children and adolescents are shown in the box on page 88.

## Diagnosis

### Infants and young children

In the infant or younger child, refractive errors should be excluded if a squint or amblyopia is present. A significant error should be suspected if you must rack up more than -1 or +3 on the ophthalmoscope to get a clear view of the fundus

Figure 1. Refractive errors may be estimated easily in young children. Accommodation is paralysed using a cycloplegic agent, and refraction is then measured using a retinoscope and a box of lenses.

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**continued**

## Refractive errors and their correction

### Hypermetropia

In hypermetropia (long sightedness), the focal point of light rays from infinity (that is, parallel rays) is behind the retina (theoretically), and accommodation is necessary to bring them to focus on the retina. Mild hypermetropia is the rule in infancy and early childhood.

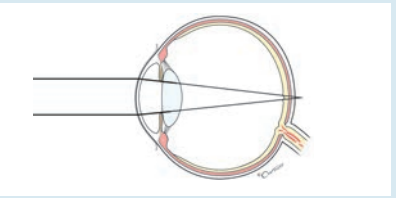


Figure 2a. Hypermetropia. Light rays focus behind the retina.

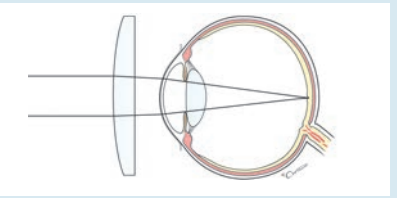


Figure 2b. Hypermetropia corrected using a convex lens.

### Myopia

In myopia (short sightedness), light rays from near objects are divergent and thus focus on the retina without the need for accommodation. However, rays from distant objects focus in front of the retina, and can only be focused on the retina with the help of concave lenses.

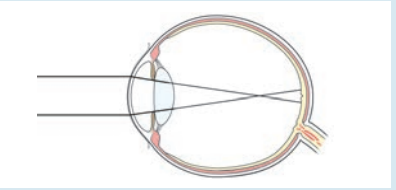


Figure 3a. Myopia. Light rays focus in front of the retina.

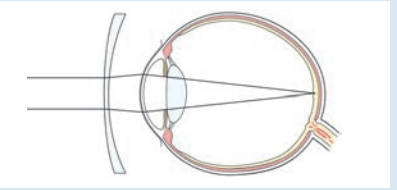
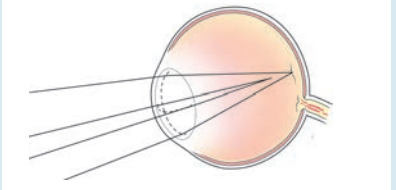
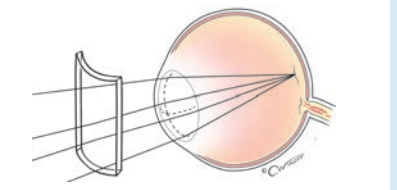


Figure 3b. Myopia corrected using a concave lens.

### Astigmatism

In astigmatism, light rays are prevented from coming to a single focus on the retina because they are refracted differently by different meridians of the cornea. An astigmatic surface can be thought of as resembling the back surface of a spoon, which is more curved in one plane than another. Astigmatism is very common in infancy.





Figures 4a and b. Astigmatism. a (left). Light rays are prevented from focusing on the retina by abnormal corneal curvature. b (right). Astigmatism corrected with a cylindrical lens.

### Emmetropia (no refractive error)

Light rays from infinity focus on the retina without the use of accommodation.

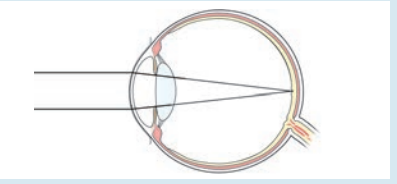


Figure 5 (right). Emmetropia. No accommodative effort is required.

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through a dilated pupil (after the viewer's refractive error is taken into account). Precise measurement of refractive errors in children is possible, and requires use of a retinoscope (Figure 1).

Anisometropia (unequal refractive errors) is a common cause of amblyopia, particularly if one eye is more hypermetropic than the other. Patients are rarely symptomatic, rarely develop squints and they function normally using the better eye. Anisometropic amblyopia is usually detected in preschool screenings, but treatment is often difficult because visual development is by then in a late stage.

It is, however, easy for GPs to detect anisometropic amblyopia at an earlier age using a direct ophthalmoscope to view the Bruckner reflex (see the box on page 89). In children with anisometropia, the more hypermetropic eye will often have a slate grey reflex compared with its fellow; if an eye is very hypermetropic, the reflex will look dull because of the defocusing of light within the eye. GP screening for anisometropic amblyopia is therefore very important because it will enable detection at an age when visual acuity cannot be assessed directly and will allow early intervention.

### Older children

In a child who is old enough to speak, a refractive error should be suspected after complaints of blurring vision (particularly for distant objects such as a blackboard) or visual fatigue (especially after visually demanding tasks such as reading).

The task of deciding whether an error is present is much easier in an older child because visual acuity for distance can be assessed formally using the Snellen chart and for near objects using a near-reading card. If the uncorrected distance vision is less than 6/9 and near vision is good in a child over 5 years of age, myopia should be suspected. If the visual acuity for near or distant objects improves when looking through a pinhole, a refractive error is almost certainly present.

## The Bruckner test

The Bruckner test is a comparison of the red reflexes of the fundi. It is a practicable procedure for use in general practice to screen for anisometropia in early childhood.

The test should be performed in a darkened room using an direct ophthalmoscope with the lens wheel set at zero (an instrument with a rechargeable handle and halogen bulb is best). The patient's attention should be attracted to the ophthalmoscope (but this usually happens naturally), and the red reflexes viewed at arm's length through the instrument.

The important point of the Bruckner test to remember is that asymmetry of the reflexes indicates abnormality. In a child who is fixating normally, light from the ophthalmoscope is reflected back from the centre of the fovea – as in a concave mirror (Figure 6a). However, if one eye is not fixating centrally, the light will be scattered and enter the viewing hole of the ophthalmoscope, and the affected eye will have a brighter reflex than its fellow (Figure 6b).

The Bruckner test has a sensitivity of over 95% for amblyopic eyes, but it has a significant false-positive rate. The test is not sensitive in infants under 6 to 9 months of age, but screening of newborns is recommended to detect cataracts (these are outlined against the red reflex). Be aware that anisocoria (unequal pupils) will of necessity produce unequal red reflexes.

Figure 6a. A normal Bruckner reflex. Note the symmetrical light reflections from the eyes.

Figure 6b. A positive Bruckner reflex showing asymmetrical reflections in a child with a right convergent squint.

## Treatment

Appropriate glasses or contact lenses should be prescribed for children with refractive errors that are causing symptoms or are suspected of causing a squint (see the box on page 88). Anisometropia requires treatment if the difference is sufficiently large to cause amblyopia – note that in the hypermetropic child one dioptre of difference between the eyes can cause amblyopia. Eye patching may also be necessary.

In order to prevent eye trauma, 'glasses' for children (when indicated) always contain plastic lenses which have much greater impact resistance than glass ones. Most children who are prescribed the correct glasses are happy to wear them. In order to encourage infants to wear their glasses, it may be necessary to attach cotton tape, loose elastic or velcro straps to the back of the frames. Old wives' tales such as 'glasses weaken the eyes' may require sympathetic discussion to reassure parents.

Note that very few children or adults are truly emmetropic (Figure 5), and that many children are prescribed glasses unnecessarily for trivial deviations from the norm. An association between mild or moderate refractive errors and school performance is, at best, a tenuous one. MT