

Refractive errors

Refractive defects of the eye are caused by poor properties of its refractive surfaces depending on the projection of the image on the retina^[1]. So it is not the focal point of the eye's optical system. This phenomenon is caused by incorrect refraction of light rays, or more often by axial defects of the eye (refractive mediums are fine, but do not correspond to the length of the eye). Axial and refractive (refractive) defects manifest themselves in the same way and can even be combined.

Normal refraction

In a healthy eye, the rays passing through the optical system intersect at a focus on the surface of the retina, and such an eye is called **emmetropic**. When viewing objects close to the eye, focusing occurs by changing the shape of the lens (accommodation)^[2].

Refractive errors

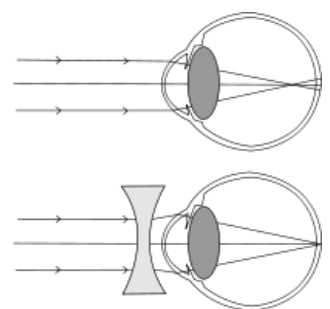
An **ametropic** eye is when the rays do not intersect on the retina. Refractive disorders are divided into spherical and aspherical. **Spherical** ones are independent of the orientation of the bulb and are corrected by lenses symmetrical in both axes. These include **myopia (nearsightedness)** and **hypermetropia (farsightedness)**. We correct **aspheric** defects with aspheric (so-called toric) lenses. The most common aspheric disorder is **astigmatism**. Eye defects include **presbyopia**. Here, however, it is a natural process of loss of flexibility of the optical apparatus of the eye and thus a reduction of accommodation abilities in older age.

Myopia (nearsightedness)

Spherical defect of the eye. We distinguish **axial** myopia (axis, -is, f. is an axis) - the eye is too long, or **refractive** myopia - optical environments have a greater refraction. Both types result in **rays passing through the eye intersecting in front of the retina**.

The far point moves to a final distance in front of the cornea. The near point distance is also shortened. It is manifested by **blurred vision of more distant objects**. But a short-sighted person is able to distinguish the details of objects from a smaller distance.

This eye defect is very widespread. In Europe and America its incidence is reported to be between 20-40%, in Asia the incidence ranges from 50-80%. Various studies have shown a large role of environmental influences and lifestyle, of which the greatest influence is close work and probably also the composition of the diet, which can change the composition in the sclera. On the contrary, hereditary dispositions have not been proven, even if they are assumed.



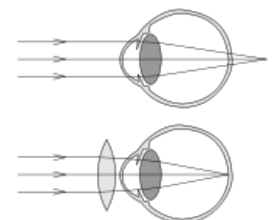
Principle of myopia and its correction with a diverging lens

Hypermetropia (farsightedness)

Spherical defect of the eye. Again, we distinguish **axial** hypermetropia - the eye is too short, or **refractive** - optical environments have less refraction. Both types cause **the imaginary focus to shift behind the retina**. There is practically no focal point - the rays hit the retina before they intersect.

The far point is moved to the final distance behind the eye. The near point is quite far from the eye - either in front of or behind the eye. It manifests as blurred distance vision and very **blurred near vision**.

Hypermetropia is natural in children. +2 D, +3 D and more are common. Even at 5 years old, 90% of children are farsighted. This defect usually disappears as the eye develops, but it persists to a small extent in almost 50% of individuals. In younger people, it usually has no clinical manifestations. However, with increasing age, the accommodative properties of the eye deteriorate, which results in manifestations of even minor defects.



The principle of hypermetropia and its correction with a contact lens

Astigmatism

Aspheric refractive error. **Congenital** can be caused by a curvature defect, incorrect centering or refractive index of individual parts of the optical system of the eye - most often the cornea, less often the lens. Changes in curvature can also occur as a result of injuries, surgeries and corneal diseases, such astigmatism is called **acquired**. The cornea has a different curvature in two mutually perpendicular planes - the "toric curvature of the cornea". Rays passing through the eye form a focal point not in one, but in two different planes. The distance between these foci is called the focal interval. The degree of astigmatism is determined by its length.

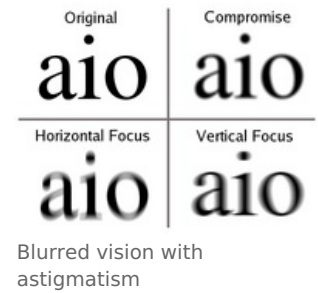
With minor astigmatic defects, patients usually close their eyelids or tilt their head in an attempt to eliminate the optical defect. This is especially dangerous for young children, who can develop spinal defects, such as scoliosis. Uncorrected (or poorly corrected) astigmatism can cause headaches, neurasthenia and irritability.

Presbyopia

A natural irreversible event, when the **accommodative width decreases** mainly due to the **loss of flexibility** of the lens.

The human lens grows throughout life. After the age of 40, this growth leads to a loss of elasticity of the lens capsule. Also, the suspension apparatus is tied to the larger lens in a different direction and its pull is less effective. Movement of the ciliary muscle is limited due to hypertrophy of its circular part.

Presbyopia is manifested by **lengthening the reading distance** ("short hands", aptly in Russian "blizorukij"), **a decrease in sharp near vision** in low light, inability to focus at a short distance, **blurred vision** when looking from near to far. Visual difficulties are later joined by eye fatigue and pain, headache, tired appearance and congestion of the conjunctiva.



Links

Related articles

- Correction of the refractive errors of the eye
- Optical apparatus of the eye
- Eye (biophysics)
- Eye and Vision Disorders (Paediatrics)

Bibliography

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2. Mark Batterbury, Bradley Bowling, Conor Murphy. . *Ophthalmology : An Illustrated Colour Text*. - vydání. Churchill Livingstone, 2009. 125 s. ISBN 9780702030598