DEFECTS OF HUMAN EYE

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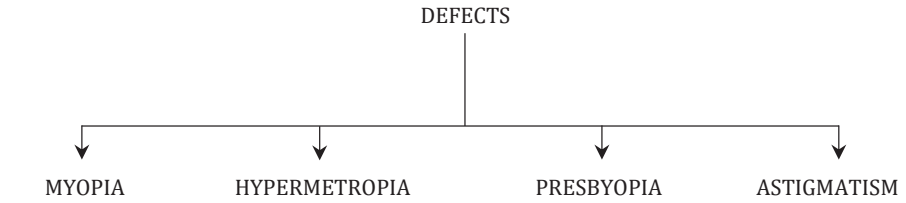
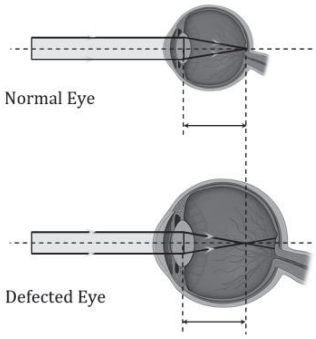


Normal	Myopic	Hypermetropic
Distant Object	Blur	Clear
Nearby Objects	Clear	Blur

Myopia (Short-sightedness)

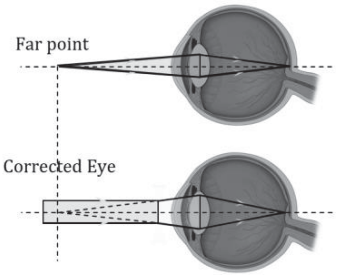
In the realm of vision, the human eye possesses an innate ability to focus on both distant and nearby objects. This is made possible by the eye's lens, which boasts a short focal length, enabling it to observe nearby objects with precision. Interestingly, lenses with varying curvatures exhibit distinct focusing capabilities: those with larger curvatures excel at focusing on nearby objects, whereas those with smaller curvatures are adept at capturing distant objects. Notably, the manifestations of visual defects often emerge at the fringes of the visual spectrum.



Myopia, often referred to as nearsightedness, occurs when the eye encounters difficulty focusing on distant objects because its lenses lack a sufficient focal length. Those affected by this condition commonly find their vision clear for nearby objects. Abundant illustrations and detailed ray diagrams illustrating the eye's functions provide ample evidence that increased refraction of light interferes with the eye's capacity to create clear images of distant objects.

Correction for Myopia

In the myopic eye, the farthest point of clear vision moves closer to the eye and is no longer at an infinite distance.



Adjusting the point at infinity to coincide with the far point of the defective eye.

Myopia causes

Genetics is among the inherent factors contributing to the development of myopia in individuals. If either parent possesses this defect, there is a likelihood that their offspring will inherit it as they mature into adulthood.

Primarily, young individuals are affected by myopia, which arises from the elongation of the eyeball or the bulging of the cornea. When the cornea's curvature deviates from the norm, light rays refract in a manner that results in the image forming in front of the cornea. Within our eyes, the rods and cones possess specific areas where images achieve optimal clarity when focused. Consequently, since distant objects' images fail to form precisely, they appear blurry to the observer.

Symptoms of Myopia

A prevalent indication of short-sightedness, or myopia, includes squinting and frowning. Those with short-sightedness may experience fatigue in their eyes and endure intense headaches from overexerting them. Another straightforward symptom is struggling to read alphabets or letters from a certain distance.

Myopia Mathematically

The formula utilized for determining the power of the corrective lens for myopia involves employing an approximate formula derived from the focal length of combined lenses, which is expressed as:

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

Where,

- f is the effective focal length
- f_1 is the focal length of the lens required
- f_2 is the focal length of the human eye

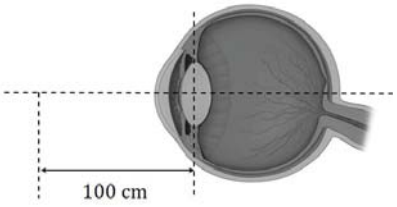
Ex. An observer can see objects only till 100 cm. Find out the lens (focal length, nature) required to correct his vision"

Sol.

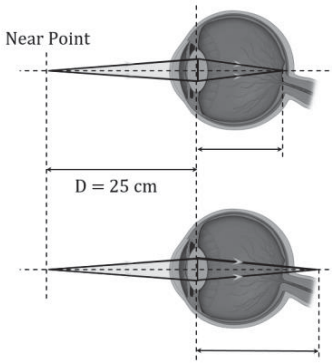
$$u = -\infty v = -100 \text{ cm}$$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

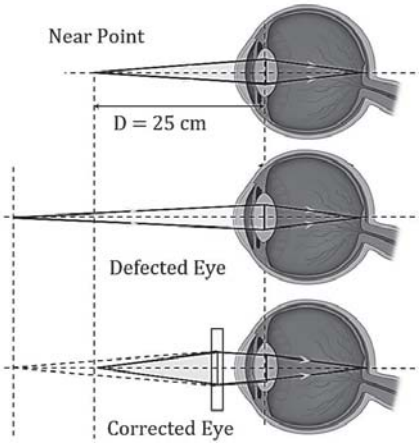
$f = -100$ cm Concave Lens



Hypermetropia (Far-sightedness)



Near point of the hypermetropia eye shift away from the eye and become greater than 25.cm.



Hypermetropia (Far-sightedness)

Hypermetropia, also known as hyperopia or long-sightedness, is a condition of the eyes where the image of a nearby object is projected behind the retina. In this scenario, light converges behind the retina rather than precisely on it.

Those suffering from hypermetropia face difficulties focusing on nearby objects while generally maintaining clear vision of distant objects. Accommodation serves as a method to manage hypermetropia, especially during its initial phases, without compromising overall visual acuity.

Hypermetropia primarily arises from structural abnormalities within the retina. These irregularities include:

Small-sized eye-ball
Non-circular lenses
The cornea is flatter than usual
Defective blood vessels in the retina
Weakness in ciliary muscle
Changes in the refractive index of the lens
Alterations in the position of the lens or absence of lens
Low converging power of eye lens

Risk factors include:

Cancer around the eye
Some medications
Diabetes
Small eye syndrome (microphthalmia)

Symptoms

Initially, this condition may not exhibit prominent symptoms, but over time, it can result in mild light sensitivity, blurred vision, excessive tearing, eye fatigue, inward turning of the eyes, and may also cause headaches.

Types of Hypermetropia

In clinical practice, far-sightedness is categorized according to the structural appearance of the eyes, the severity of the condition, or the response of the eyes to accommodative changes.

Based on the structure of the eye, hyperopia is classified into:

- Simple hyperopia: It is caused due to biological diversity.
- Pathological hyperopia: It is caused by abnormal development of the eye, disease, or trauma.
- Functional hyperopia: It is caused by paralysis that interferes with the eye's ability to accommodate.

Hypermetropia is categorized into different degrees of severity.

- Low Hypermetropia: Refractive error is less than or equal to +2.00 diopters (D).
- Moderate Hypermetropia: Refractive error is more than +2.00 D up to +5.00 D.
- High Hypermetropia: Refractive error is beyond +5.00 D.

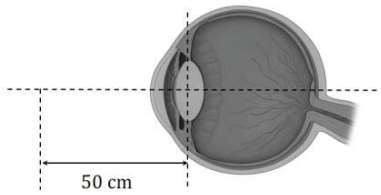
Hypermetropia is classified based on how the eyes respond to accommodation.

- Total hypermetropia
- Latent hyperopia
- Manifest hyperopia

Ex. An observed can see object beyond 50 cm find out the nature of the lens with its focal length to correct his vision.

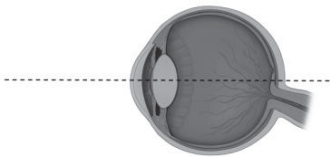
Sol. $u = -25$ cm $v = -50$ cm

$f = +50$ cm Convex lens



Ex. An observed can see object beyond 80 cm find out the require focal length of lens for his eye?

Sol. $\frac{400}{11}$ cm to infinity



Presbyopia

It is a visual impairment commonly experienced by elderly individuals, resulting in difficulty seeing objects both nearby and at a distance with clarity.

Causes Presbyopia

Weakening of ciliary muscles.

Decrease in the flexibility of the eye lens.

Astigmatism

It is a refractive error where light rays fail to converge onto a point on the retina.

Causes Astigmatism

Different radius of curvature of the eye at different locations.

Unequal refraction of light in different meridians