

## *Refractive Errors*

The optical power of the eye is attributed to the cornea ( 43 Diopter ) and the Lens ( 15 Diopter ).

*Emmetropia* is the refractive state in which parallel rays of light from a distant object are brought to focus on the retina .

Ametropia refers to the absence of emmetropia.

▪65% of the population have refraction of 0.00 to +0.75 and can therefore regarded emmetropic,

In *axial ametropia*, the eyeball is either unusually long (myopia) or short (hyperopia).

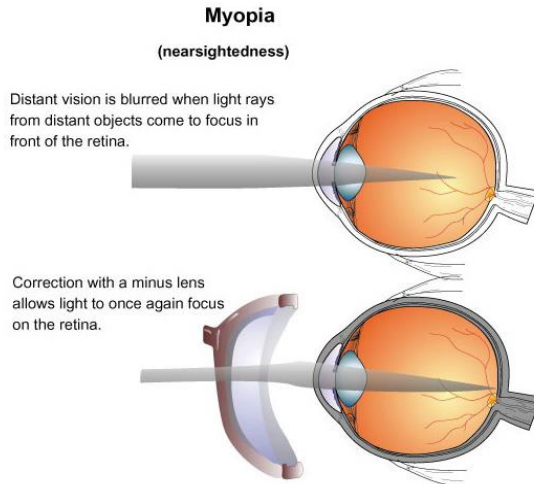
In *refractive ametropia*, the length of the eye is statistically normal, but the refractive power of the eye is abnormal: excessive in myopia or inadequate in hyperopia. Aphakia is an example of extreme refractive hyperopia.

An ametropic eye requires either a diverging or a converging lens to focus a distant object on the retina.

### **Myopia**

The myopic eye possesses too much optical power for its axial length. In myopia light rays from an object at infinity converge too soon and thus focus in front of the retina .The main symptom is blurring of vision especially for far.

Myopic eyes tend to be large with deep anterior chamber



### **Aetiology :**

1. Axial Myopia :
2. Refractive Myopia : e.g nuclear sclerosis and keratoconus .

According to the degree of refractive error (measured in Diopter), myopia can be classified into:

1. Simple myopia (5-6 D)
2. Pathologic myopia ( more than 6D):-associated with progressive excessive elongation of the globe often followed by degenerative changes involving the sclera, choroid, Bruch's membrane, RPE and the sensory retina .

Signs of pathological Myopia include:

1. Tilted optic disc and peripapillary atrophy.
2. Chorioretinal atrophy involving the posterior pole and / or the retinal periphery .
3. Macular changes
4. Retinal detachment .
5. Cataract and lens subluxation.
6. increased prevalence of primary open angle Glaucoma.
7. Posterior staphyloma which is an out bulging of the thinned sclera at the site of exit of the optic nerve.

**Treatment:-**

Patients with pathological myopia should have their Fundi routinely examined with well dilated pupils and their visual symptoms taken seriously.

Optical correction include

1. Concave (minus lenses)
2. contact lenses
3. Radial Keratotomy (old almost obsolete procedure).
4. Clear lens extraction :gives very good visual results but small risk of retinal detachment.
5. Photorefractive procedures: PRK and LASIK the procedure performed with excimer Laser which can accurately ablate corneal tissue to an exact depth with minimal disruption of the surrounding tissue. Ablation of the central cornea 10 micrometers can correct 1D myopia. 6 - 12 Ds of myopia can be corrected with this procedure.
6. Intraocular Collamer lens implantation (ICL) can correct up to -17.0 Diopters of myopia.

**Hyperopia:**

The Hyperopic eye does not possess enough optical power for its axial length .

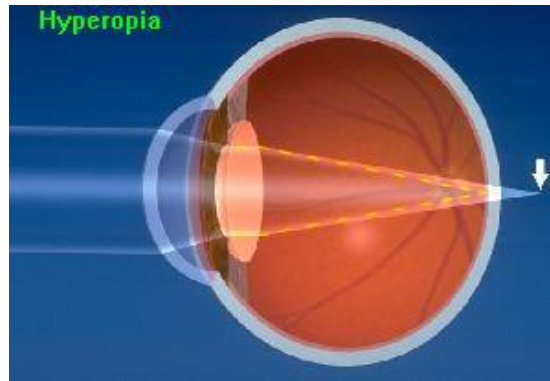
In hyperopia ,an object at infinity focuses behind the retina .

Accommodation :

In order to bring the images of nearer and nearer objects to focus on the retina ,the optical power of the eye has to increase .This process is called accommodation which usually occur in synergism with convergence and pupillary miosis. Children usually have high ability to accommodate and this in turn play a role in development of some kinds of strabismus.

**Aetiology:**

1. Axial Hypermetropia.
2. Refractive Hypermetropia: e.g. when the cornea is flatter than normal for that particular eye(curvature hypermetropia) which may be congenital (cornea plana) or acquired (trauma to the cornea with subsequent scar formation ).



**Hypermetropia can be classified into:-**

- a. *Total hypermetropia*: is the amount of hypermetropia after all accommodation is suspended (using cycloplegic drops e.g. atropine or cyclopentolate).determination of total Hypermetropia is important in management of children with strabismus.
- b. *Manifest Hypermetropia*: is the strongest convex lens accepted for clear distant vision.
- c. *Latent Hypermetropia*:is the difference between total and manifest hypermetropia.

At birth 90-95% of new born eyes are hypermetropic to the extent of 2.5-3D because they have a short axial length .Thus , in the absence of strabismus such children rarely need spectacles .

**Clinical Features:**

Blurring of vision esp. for near and symptom of eye strain like headache and ocular pain due to excessive accommodation however some patients might be almost asymptomatic especially in low degrees of hyperopia .

Hyperopic eyes tend to be bit smaller in size with shallower anterior chamber than emmetropic eyes.

Excessive accommodation may result in excessive convergence and esotropia

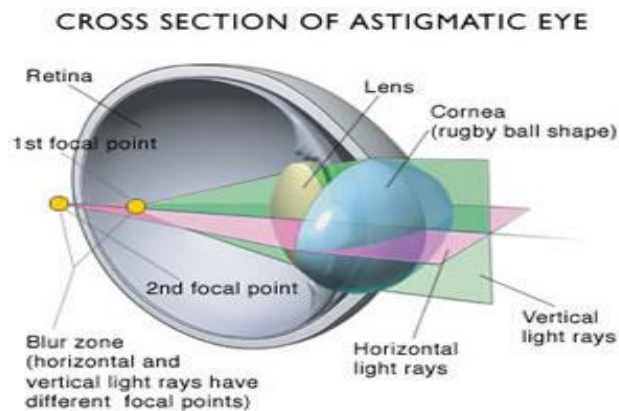
**Treatment** : after determination of the degree of R.E. , treatment options include:

- 1.Convex (plus) lenses to bring the image from behind the retina a new focus on it.
- 2. Contact lenses

3. Photorefractive Keratectomy (PRK) and LASIK can correct hypermetropia by ablating the corneal periphery. LASIK can correct up to 6 Diopters.

### **Astigmatism**

In astigmatism, variations in the curvature of the cornea or lens at different meridians prevent the light rays from focusing to a single point i.e. the refractive power of the eye varies in different meridians and a focus line rather than point is formed .



### **Types of Astigmatism:**

#### **1) Regular Astigmatism :**

the two principal meridians are at right angle to each other and is correctable with cylindrical spectacle lenses. it is further subdivided into:-

- Simple myopic: one line focus lies on the retina and the other lies in front of the retina.
- Simple Hypermetropic: one line focus lies on the retina and the other lies behind of the retina.
- Compound Myopic: Rays in all meridians come to focus in front of the retina.
- Compound hypermetropic: Rays in all meridians come to focus behind of the retina.
- Mixed: one line focus lies in front of the retina and the other lies behind the retina.

#### **2) Irregular astigmatism:**

If the orientation of the principal meridians changes from point to point across the pupil,

Or if the amount of astigmatism changes from one point to another, the condition is Known as irregular astigmatism. Cylindrical lenses can do little to improve Vision in these cases, although rigid contact lenses may be useful.

**Treatment:-**

1. Cylindrical lenses
2. Soft contact lens may be used if astigmatic error is less than 2D, while rigid contact lenses may be used for higher degrees.
3. Photorefractive surgery weather PRK or LASIK.
4. Advanced Keratoconus may benefit from intrastromsl corneal rings or even corneal grafting.

**Presbyopia**

Is an age related process represents loss of the eye to its ability to accommodate for near objects . It usually manifest around the age of 40 . Plus lenses are used to deal with this condition.