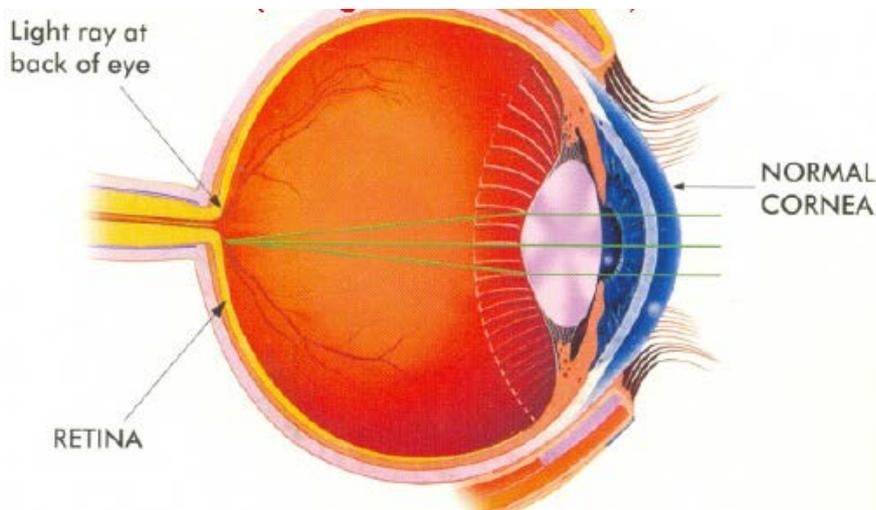


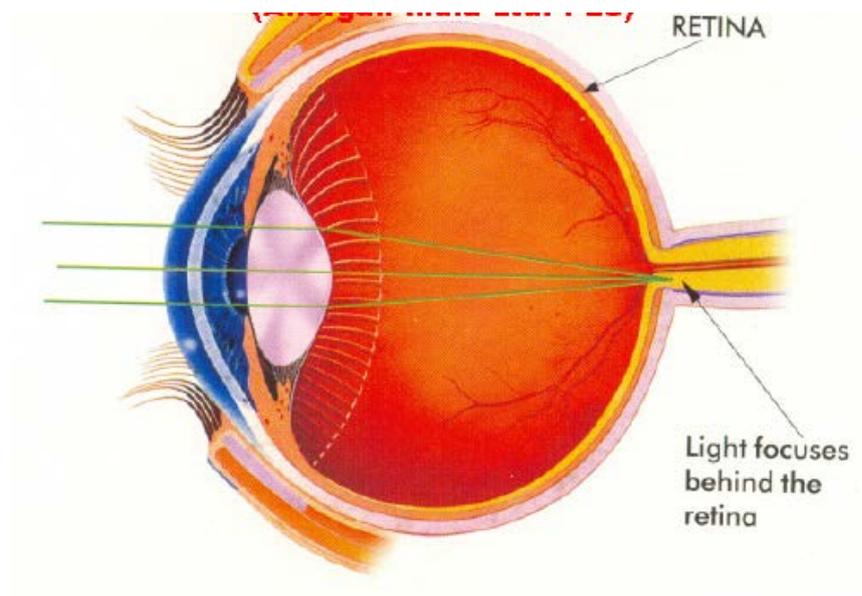
The errors of refraction

The Normal Eye



In the normal eye the refractive components of the eye include the cornea, the lens (shown in white) and the vitreous gel (behind the lens). The combined refraction of these elements is thus that rays of light reflected off objects in the front of the eye are focused on the retina. When such a refractive state occurs, a state of normal vision exists as shown in the diagram above. Unaided vision will then be declared 6/6 (or 20/20).

Hypermetropia (or hyperopia) and presbyopia



What is it?

Also called far-sightedness, or far-sighted and hyperopia. Rays of light reflected off objects in front of the eye are focused behind the retina as shown above. Such persons can see well in the distance provided they are young and the refractive error is not large. This error of refraction is corrected by a "+" (convex) lens.

Why does it occur?

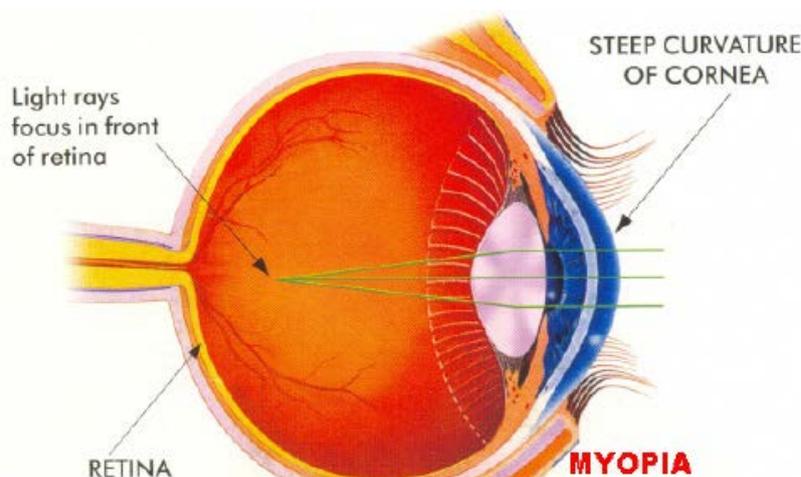
Most of cases of hypermetropia are axial, that is the length of the eyeball is shorter than it should be. In some cases, the cornea may be flatter than normal. Hypermetropia actually forms a stage in normal development of the eyes. At birth practically all eyes are hypermetropic to the extent of 2.5 to 3.0 Diopters and as the growth of the body starts, the length of the eye increases until adolescence is passed, the eye should theoretically be "normal" in size and refraction. Hypermetropia therefore represents an imperfectly developed eye when it persists in adult life. Hypermetropia can also occur due to change in refractive index of the crystalline lens of the eye, as in cataract.

Another form of Hyperopia is **Presbyopia**, which affects individuals after or near 40 years of age. This is because age related loss of "accommodation" due to decreased elasticity of the crystalline lens surface (capsule). Persons with presbyopia have difficulty in reading/writing and doing near work. This refractive error is corrected by adding a "+" lens to the current refractive correction the person is wearing.

Symptoms

The earliest symptoms of uncorrected hypermetropia are "eye-strain", "watering", "redness" of the eyes, and often headaches in the later part of the day. Presbyopic persons complain of blurring of text specially after some time. Young children with significant hypermetropia can also develop a convergent squint.

Myopia



What is it?

Also called short-sightedness or short-sight, because the person affected is able to perform near work without correction, and has difficulty defining distance objects. Rays reflected off an object in front of the eye focus in front of the retina. A "-" or concave lens is needed for correction of this refractive state.

Why does it occur?

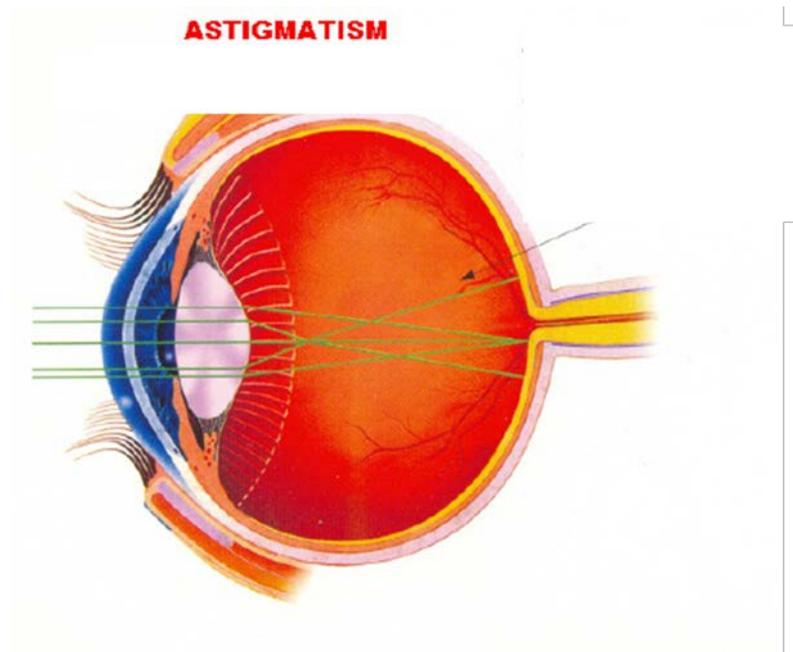
In the great majority of cases the cause of myopia is an increased length of the eyeball. But it may also be due to an increase in the curvature of the cornea or the surfaces of the crystalline lens. Cataract can also produce myopia. Myopia is of two types. A simple myopia in which there is only a myopic state in the eye, the commonest form of myopia, and no damage to the retina, and pathological myopia in which there is damage to the retina of the eye. Myopia can also be progressive if the negative power continues to increase over a time period. Myopia in childhood may be associated with a divergent squint.

Presbyopes with myopia are able to do their near work without glasses as the negative correction in myopia cancels the positive correction of presbyopia (this is of course applicable to lower refractive errors); as compared to hypermetropes who need presbyopic correction at an earlier age.

Symptoms

Typically uncorrected myopes do not have "eye-strain", "watering" of the eyes or headaches as often as hypermetropes do. The myopia is usually detected in the young when children playing with each other discover that they can not see distant objects as well as their friends do, or the class-teacher complains that the child makes too many mistakes copying things from the black-board.

Astigmatism



What is it?

Rays of light reflected off objects in front of the eye are focused differently on the retina of the eye, because more than one focal point exists. Astigmatism is due to distortion of the corneal surface in one or multiple planes. A cylindrical lens with either "+" or "-" power is required to correct the refractive error.

Why does it occur?

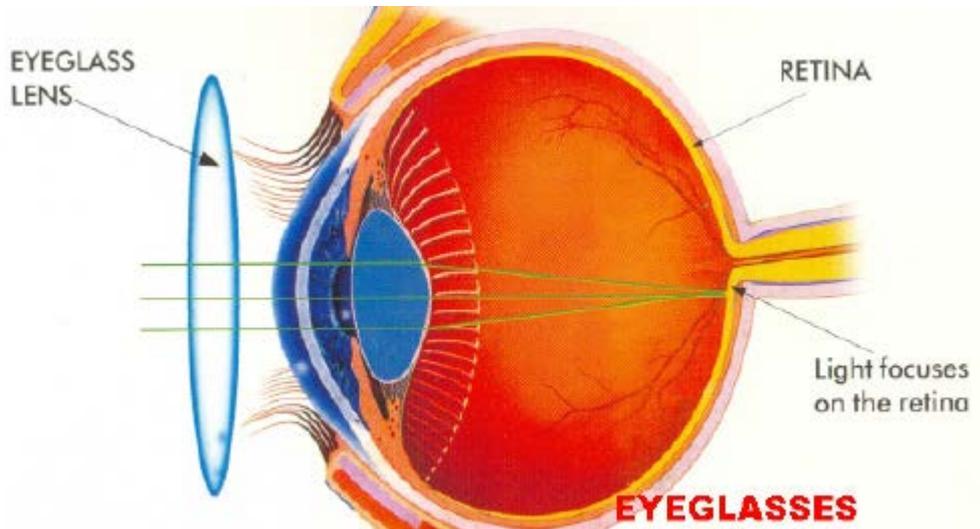
Astigmatism may either be an error of curvature, of centring, or of refractive index. Curvature astigmatism of any degree occurs in the cornea. The commonest error is one wherein the vertical curvature is greater than the horizontal. Injuries to the eyes, surgeries in the eyes can cause astigmatism.

Symptoms

Astigmatic persons often complain of headaches, low vision or reduced vision for distance and near, "watering", "redness", "foreign body sensation" in the eyes as the day progresses. Such persons may also complain of "running together of text" while reading. An astigmatic person can see well neither a distant nor a near object, more so the difficulty is with distant objects. In uncorrected astigmatism with oblique axes there may be a compensatory tilt in the head posture.

Correcting refractive errors of the eye

Spectacles (Eyeglasses)



By far the commonest used correction for refractive errors are spectacles. An optometrist/Ophthalmologist perform either a subjective or an objective assessment of your vision and prescribe the lenses (and even dispenses) you will need for your refractive error.

The advantages of using spectacles:

1. Cost effective
2. Freely available even in remote places
3. Can be worn and removed easily
4. Can be cleaned easily

The disadvantages:

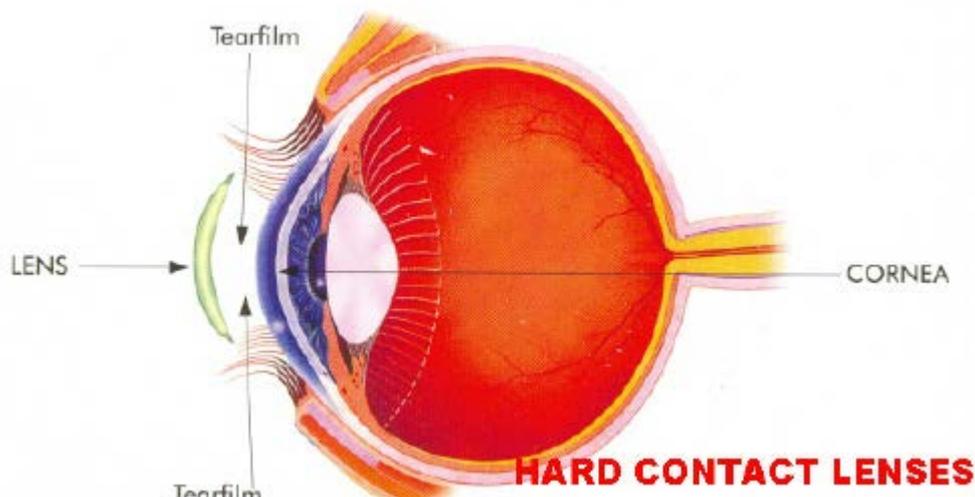
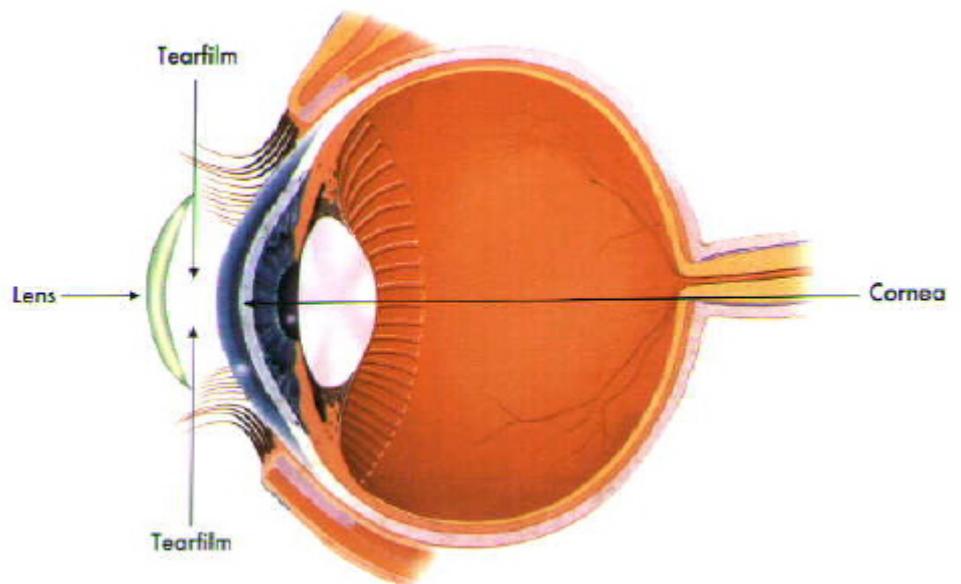
1. Difficult to handle for children and sports persons
2. Misplaced or lost easily
3. Accidental breakage and "scratching" more common
4. Provided limited field of peripheral vision in high refractive error
5. Peripheral distortion specially in high powered lenses
6. "Heavy" to wear specially in high powered lenses
7. Some persons are prone to dermatitis over the bridge of the nose (contact dermatitis)
8. Some persons find it difficult to adjust to bifocals, trifocals and multifocals
9. Social stigma specially in children in some society

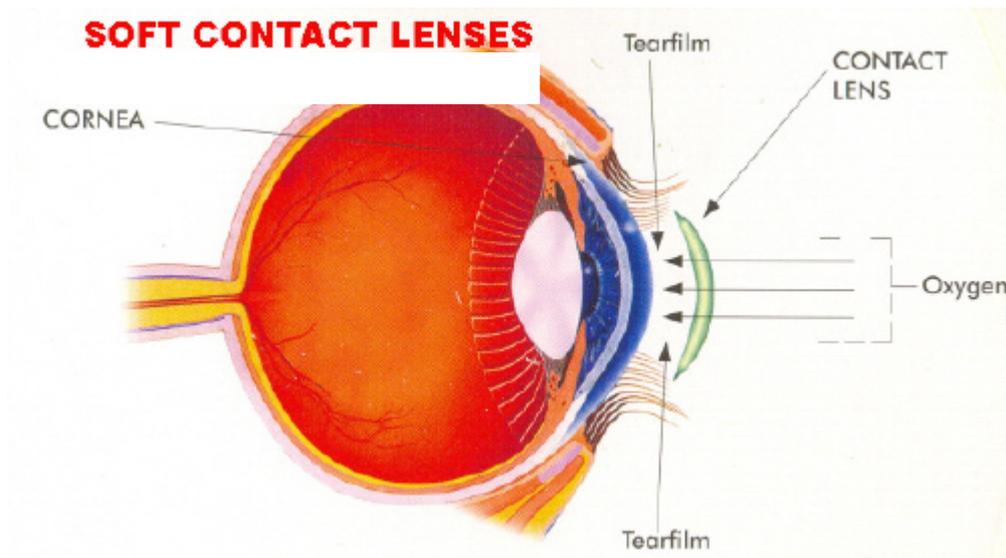
Contact Lenses

Contact lenses rest on a thin layer of tear film on the front surface of the eye (the cornea). Various derivatives of Acrylic material are used in the manufacture of contact lenses. Such lenses can be of 3 types;

1. Hard lenses
2. Semisoft or Gas Permeable lenses
3. Soft lenses

The most commonly used contact lenses now a days are the soft lenses, though semisoft (gas permeable lenses) are indicated occasionally. Both soft lenses and semisoft lenses are gas permeable, that is, they allow the cornea to "breathe" through the lenses, making them more comfortable to wear.





The Advantages;

1. Better field of vision
2. Overcome peripheral distortions in spectacles specially if the power requirement is high
3. More suitable for sports persons and similar professions
4. Cosmetically more acceptable
5. Freely available
6. The only form of correction for irregular corneal surfaces (irregular astigmatism) and mild corneal scars

The Disadvantages;

1. Require more maintenance (or meticulous maintenance)
2. Chances of infection in the eye are more common if cleanliness is inadequate
3. Require better hand-eye co-ordination while wearing
4. Cannot be used without supervision by children and mentally handicapped
5. More chance of injury to the eye in case of an accident specially with hard and semisoft lenses
6. Cannot be "over-worn" (most lenses have a wearing time of 8-12 hours/day)
7. Uncomfortable to use in dusty, humid, or polluted environments, or in the presence of chemical fumes, etc.
8. Costlier than spectacles

The Surgical Correction of Refractive Errors

There are numerous surgical procedures for the correction of all types of refractive errors. Most of the procedures are aimed at altering the front surface of the eye (the cornea) so that a state of normal refraction can be achieved. Surgical procedures such as Radial Keratotomy are performed using a special knife, and LASIK (Laser In Situ Keratomileusis), PRK

(Photorefractive keratectomy) using a special LASER. The latest in the series of surgeries is in the form of implants within the corneal stroma "INTACS" or lens implants in the eye "phakic intraocular lens implants"

Apart from changing the surface, in case of corneal opacities and irregularities the cornea itself may be changed (corneal transplant surgeries, which may be partial thickness, or full thickness).

The Advantages;

1. In case of high refractive errors, the error may be brought down to a more manageable level so that it can be corrected by other means
2. No need for glasses, contact lenses, no maximum wearing time

The Disadvantages;

1. All surgical procedures have a statistical failure rate which may range from improper correction to loss of the eye
2. Costly instrumentation and surgery
3. Not freely available
4. Cannot be undone in most cases, sometimes residual refractive errors cannot be corrected using contact lenses or glasses
5. Stringent case selection