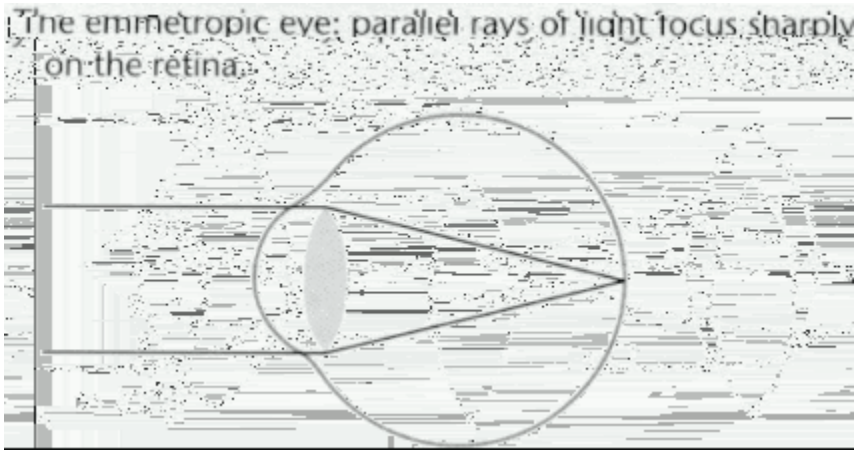
Optics

● **Emmetropic eye:-**

- Cornea=43D.
- Lens =17D.
- Axial length =24mm.



● **Diopter :** is the unit of the measuring of refractive power and is equal to the reciprocal of the focal length of a lens Power ((in meters)).

Example: a lens with focal length of (100 cm) , the power is 1/100cm = 1/1 m = 1 Diopter .

● **Ametropia:** abnormal refractive state of the eye ((there is refractive error in the eye))

● **Anisometropia :** The refractive error of the two eyes is different (not equal).

● **Accomodation :** Is the ability of the lens to change it's power to the distance of fixation on target.

The mechanism of accommodation is by active contraction of ciliray Muscle → Relaxation of zonules → increase in the thickness of the lens (by elasticity) → increase in the lens power.

-at (10y) → 14D.
-at (2oy) → 10D.

-at (50y) → 2 D.
-at (6oy) → 0.5D.

● Indications for estimation of refractive state of the eye:

1 - Visual failure → blurring of vision.
2 - Muscle imbalance → phoria or tropia.
3 - Eye strain, headache and confusion.
4 - Others → psychological upset , neurological upset or gastric upset with visual exercise

● **Types of Refractive errors ((ametropia)):**

1- Myopia . : spherical refractive error .
2- Hyper metropia. : spherical refractive error.
3- Astigmatism. : cylindrical refractive error.

● **Causes of refractive errors:**

1-Axial: The axial length of the eye is either short or long.

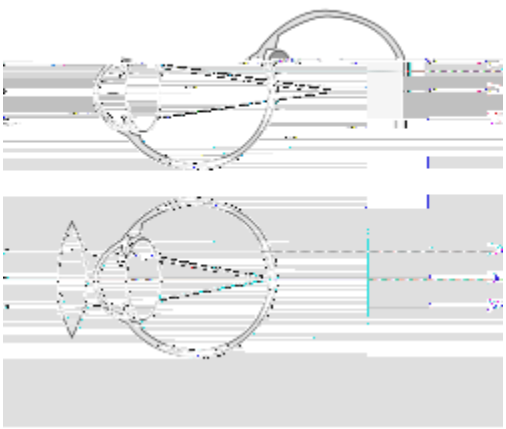
2-Refractive:

I ▪ Curvature : (increase or decrease in curvature)
i-cornea
ii-lens

II ▪ Index : Nuclear sclerosis of lens
((index Myopia))

Hypermetropia

it occurs when the dioptric power of the eye is less than normal which causes parallel rays to focus behind the retina.



Causes :-

1-Axial → short eye ball
((< 24mm))
((it is the commonest type)).
2-Rafractive → flat cornea .

3-Absence of lens → Aphakia or lens dislocation.

4-physiological ((in infants))

Types :-

1. latent hypermetropia → is the amount of hyperm. that can be corrected by accommodation.

2. manifest hypermetropia → is the amount of the hyperm .that remains after full accommodation and needs to be corrected by glasses.

3.total hypermetropia → the total amount of hypermetropia when all accommodation is suspended a it equals ((latent + manifest)).

Signs and symptoms :-

1. decreased vision → (near vision) «small degree of hypermetropia may be compensated by accommodation especially in children».

2.headache or ocular pain → by excessive accommodation.

3.couvegent squint → by excessive accommodation.

4.other non specific signs:
a. small cornea.
b. shallow AC .
c. pseudo – papilledeama.

Treatment:-

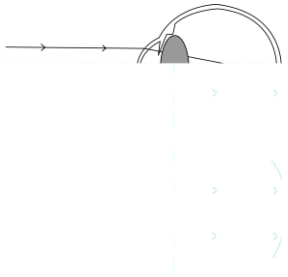
1. mild cases (especially in children) with good vision → not necessary for traetment

2. if there is decreased vision , squint or symptomatic → treatment is indicated and usually by convex lenses.

3.excimer laser → with high success up to (+ 6 diopters).

Myopia

it occurs when the dioptric power of the eye is larger than normal in which rays of light entering the eye parallel to the visual axis comes to focus in front of the retina.



Causes:-

1.Simple myopia:→ refractive ((curvature)) type .
it is the commonest, (less than 6 doipters) , and increases gradually until the age of 18 yrs.

2.Pathologic ((degenerative)) → axial type.

-((long axial length and usually more than 6 dioptres)).

-Ophthalmoscopic signs:-

a. myopic crescent of the disc.
b. staphyloma.
c. sub retinal membrane or hemorrhage.
d. retinal and choroidal degeneration.
e. retinal breaks and detachment.

3.Lenticular myopia
a. uncontrolled DM.
b. nuclear cataract.
c. lenticonus.

Signs and symptoms :-

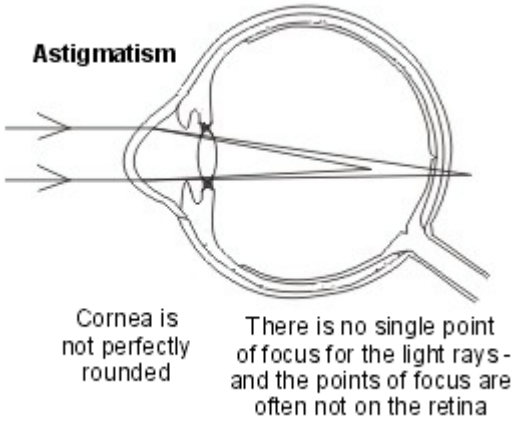
1.decreased distant vision .
2.decreased accommodation may cause exophoria or tropia .
3.non specific sings:-
a. large globe.
b. deep A.C.
c. fundus changes.

Treatment:-

1. glasses → concave glasses.
2. contact lenses.
3. surgery→ radial keratotomy ((flattening of cornea)).
4.excimer laser → LASIK.
((high successful up to 10 diopters)).

Astigmatism

it occurs when the refractive error is not equal in all meridians.



Types :

1-Regular astigmatism: ((2 meridians at right angles))

a-Meridianal : at 90 and 180 meridians .
b- Oblique : between 90 and 180 .

2-Irregular astigmatism :((no principal two meridians))

Causes :

a- scaring of cornea(trauma or ulcer).
b- keratoconus .
c- pellucid marginal degeneration.
d- surgery ((postoperative)).
e-lid mass.

Types of Regular astigmatism :

1-Myopic astigmatism : 2 types
a-simple myopic astigmatism.
b-compound myopic astigmatism.

2-Hypermetropic astigmatism : 2 types
a-simple hypermetropic astigmatism.
b-compound hypermetropic astigmatism.

3-Mixed astigmatism.

Signs and symptoms :

1. decreased vision.
2. headache → especially hypermetpic astigmatism.
3. eye strain.
4. eye fatigue.

Treatment:-

1. glasses→ cylindrical lenses.
2. contacts lenses → esp. irregular astigmatism.
3. corneal graft → keratoconus or scar.
4. Lasik.

Presbyopia

Occurs due to gradual reduction of accommodation (decrease elasticity of lens & increase laxity of zonules).

Signs and symptoms : ((start after the age of 4o years.))

1- Difficulty in near work : ((reading and sewing)).
2- Occurs earlier in hypermetropia.
3- Myopic individuals may compensate by removing their glasses.
4- Eye strain & headache with near work.

Treatment : by convex lenses (glasses)
(the power of the lens increases with age).

Aphakia

Is the absence of the crystalline lens which causes high hypermetropia and

loss of accommodation.

Causes :-

1- Surgery ((cataract surgery)) → the most common.
2- Dislocation of lens.
3- Congenital absence of the lens.

Signs and symptoms:

--Blurred vision for near and far.
-- no ocular symptoms.

Treatment :

1-Aphikic glasses ((high convex glasses)).
it has abrasions : i- magnification is (30%).
ii- image distortion.
iii- prismatic effect.
iiii- anisekonia. ((image size is not equal between 2 eyes)

2-Contact lenses: less abrasions ((magnification is 10%))

3-Intra-ocular lenses : magnification is only(1%)
-((the best))
- ((IOL is measured by biometry)).

●Measurement of refractive errors:-

1-Retinoscopy : - it is accurate .
-the most single useful method for measuring ref. errors
2-Automated Refractometers :
- not accurate.
- needs cooperative patient.

3-Keratometry : Measures the radius of curvature of cornea.
(used for contact lenses fitting & for IOL measurement)
4-Cornel topography:
-used for selected cases.

-it is computerized videokeratoscopy.
-give colored map of the corneal surface.

●Cycloplegic Refraction:

is measurement of refractive error without changes or effects of accommodation.

- usually indicated in children less than 8 years and in strabismus.
- drugs used are : i- Cyclopentolate (0.5% or 1%).
  ii- Atropine (0.5% or 1%).

● Optical devices:-

1-Spectacles : ((the most common devices)).
used for i- correcting refractive errors .
ii- incorporation of prisms.
iii-protection the eye for sun &trauma (for swimmers &workers).+

2-Countact lenses : ● Hard contact lenses.
-((poor O2 transmission)).
-((large refractive errors)).
● Soft contact lenses.
-((good O2 transmission)).
-((easily adaptable)).
- ((small refractive errors)).

▪Better V.A.
▪Used in irregular astigmatism.
▪used in anisometropia.
▪It might cause complications.

3-Intra-Ocular lenses : (IOLS).

Types: -Posterior chamber lens.(P.C).
-Anterior chamber lens.(A.C).
-Foldable lenses . (small incision).
-Accommodative lenses.

▪ Better visual acuity than spectacles & contact lenses.

▪ Cosmetically better than spectacles.

●Refractive Surgery :-

1-Radial Keratotomy:

= Stable Myopia up to (8) diopter.
= Surgical radial incisions → flattening of cornea.
= Perforation might occur.

2-LASIK :

((Laser In Situ keratomaliusis)).

=Eximer laser ((W.L. 190 nm)).
=Successful up to (- 16 D) Myopia or (+ 6 D) Hypermetropia.

advantages:

1- No surgery .
2- No scar.
3- Rapid visual rehabilitation.
4- Better results .
5- Complications are less.

3- Corneal Rings: used for correction of refractive errors with high astigmatism like (high astigmatism with keratoconus).

4- Intracollimar lenses : (I.C.L) used for correction of high refractive errors which cannot treated by Lasik.

5-keratoplasty : penetrating or lamellar keratoplasty and it used for advanced corneal diseases like keratoconus.