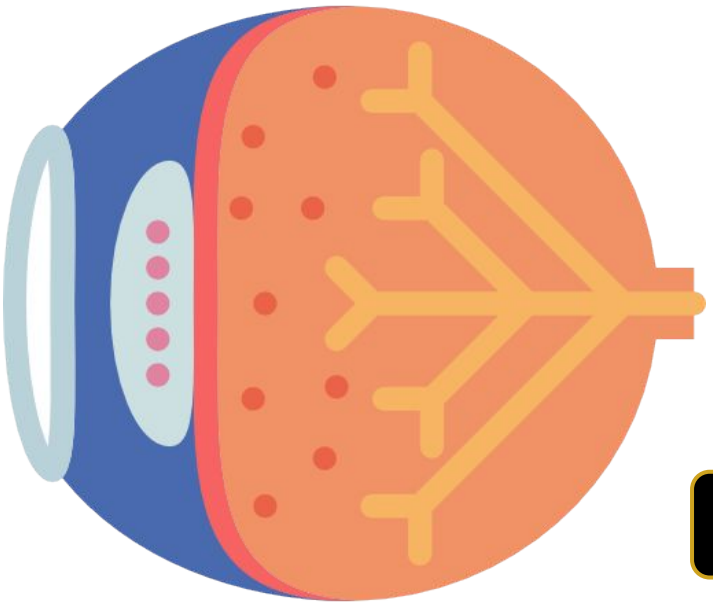
Lecture: 6



Editing file

Refractive Errors

- **Presented By: Dr. Saad Al-Dahmash / Dr. Hani AlMezaine**

- To understand the basics of optics and refraction and their importance.
- To describe the concept of accommodation.
- To identify different types of refractive errors (myopia, hyperopia, and astigmatism) and their causes, clinical manifestation and management.
- Presbyopia (definition, management).
- Anisometropia (definition, management).
- Tools for optical correction (e.g. glasses, contact lenses).
- A basic understanding of surgery for refractive errors.

Important | Doctor's notes | Golden notes | Extra | Book

OPTHALMOLOGY TEAM

How the eye works?

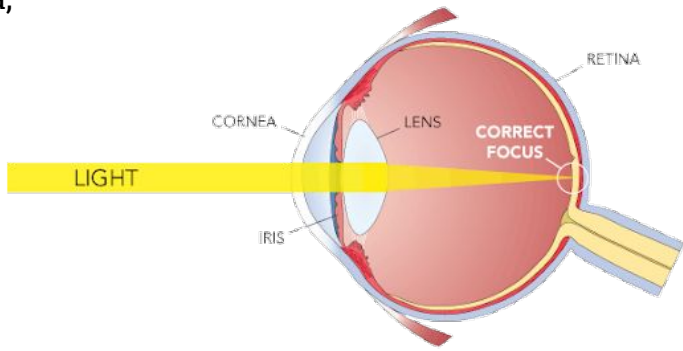
❖ Facts:

- 75% of avoidable blindness is due to:
  - **Uncorrected refractive error.** Refractive error is a common issue in the community (myopia & hyperopia and Astigmatism). Emmetropia eye is normal with No refractive errors (very rare).
  - **Cataract.** We don't consider as a pathology because it is a physiological change with age.
  - **Trachoma.** Cause by Chlamydia trachomatis (which is a bacteria behaving like a Parasite) it is transmitted via direct contact in a poor hygiene environment.
- Blindness due to refractive errors is a substantial public health problem in many parts of the world.

❖ Physiology

- Simply light enters the eye by going through the cornea where it will refract (bend) and then refract again at the lens. These two organs modify light rays by a phenomenon called refraction in order to have a single point in the fovea as it should be to see clearly.
- To have a clear picture in the retina & to be seen in the brain, there should be a clear cornea, clear anterior chamber, clear lens & clear vitreous cavity then the picture should be focused on the retina with normal refractive index.

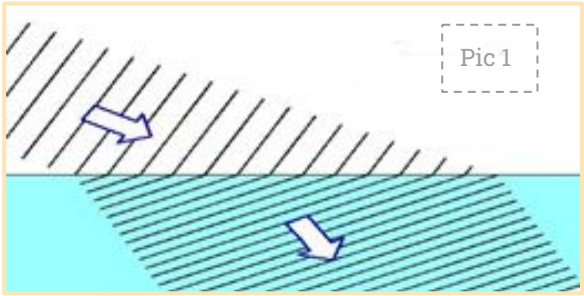
- Light rays enter the eye through a clear cornea, pupil and lens.
- **These light rays are focused directly onto the retina in the same way as a camera focuses light onto a film (the light sensitive tissue lining the back of the eye).**
- The retina is responsible for the perception of light. It converts light rays into impulses; sent through the optic nerve to your brain, where they are recognized as images.



- The eye requires about **60 diopters of power** to focus the light from a distant object precisely onto the retina (In other words, the normal refractive power of the eye is 60 diopters).
  - The cornea accounts for approximately two-thirds of this refractive power (about 40 diopters) and the crystalline lens contributes the remaining "20 diopters".
  - 60 is the power when we're looking at something far (the lens is relaxed). But when we look at near objects the lens power increases according to the distance of the object we're looking at.
  - The normal axial length is 22.5 mml (it's measured from the tip of the cornea to the surface of the retina).
  - If the axial length is longer = the picture will be in front of the retina **"Myopia"** and the power will be about 60 or more diopters.
  - If the axial length is shorter = the picture will be behind the retina **"Hyperopia"**and the power will be less than 60.

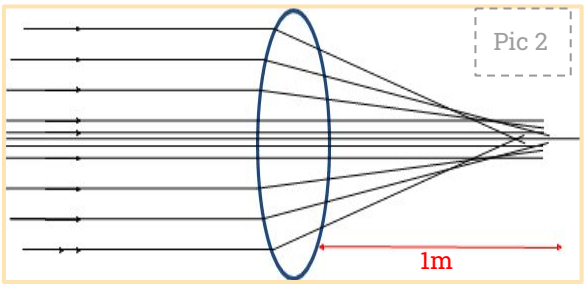
Refraction

- In optics, refraction occurs when **light waves** travel from a medium with a given **refractive index** to a medium with another. At the boundary between the media, the wave's **phase velocity** is altered, it changes direction. (Pic 1)



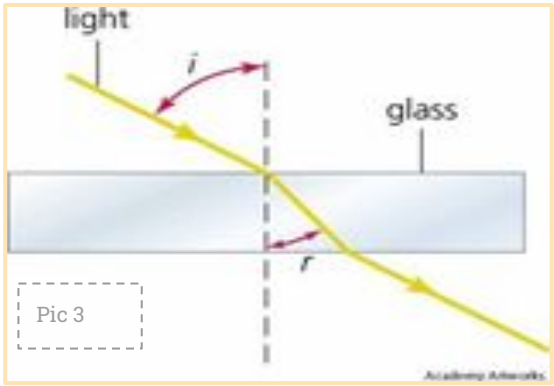
When light moves from air (lower density) to water (higher density), light waves will slow down then it will refract towards the medial vertical line (central line).

- The power of the lens is measured by the diopter (D) (the unit of refraction).
- Diopter = 1 / focal length of a lens(m). where the light rays be on one point (نقطة تقاطع الأشعة).
- The eye requires about 60 diopters of power to focus the light from a distant object (6 meters or more) precisely onto the retina.



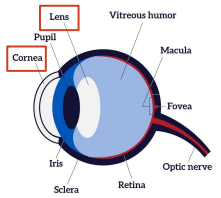
When looking at a far object, light rays are coming parallel (≥ 6 meters). It will enter through the lens and then it will refract in a single focal point at 1 meter. This is due to the power of lens, which is 1 diopter. Example: If we used another lens, rather than having a focal point at 1 meter it will be at 25 cm distance. What is the power of the lens? 4 diopter. How? diopter = 1/focal length (m) | 25 cm → 0.25 m | diopter = 1/0.25 = 4

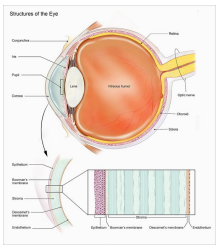
- The amount of bending depends on the refractive index of the media and the angle of incidence. (Pic 3)
  - Parallel rays = far object (at least 6 meters far).
  - Lens with 1 dioptre is a lens that can bend parallel rays to a single point 1 meter away from the lens “
- The refractive index of a medium is defined as the ratio of the phase velocity of a wave light in a reference medium to its velocity in the medium itself.
- In order for the eye to generate accurate visual information light must be correctly focused on the retina.



The Eyes optical System

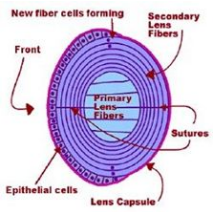
❖ Cornea:





- The main refracting surface.
- It provides 40 diopter (75% the total refracting power of the eye).
- The power of the cornea is fixed (doesn't change), it reaches its maximum power at the age of 18. That's why it's NOT recommended to do any refractive surgery before the age of 18.
  - In children the power is (32 diopter) and it reaches (40 diopter) at age of 18.
  - At the age of 40 = they will have presbyopia.
  - Power of lens at the age of 60 = 0.

❖ Crystalline Lens:



- Double purpose: balancing eye's refractive power and providing a focusing mechanism.
- The lens provides 20 diopters of refractive power. Which changes bc it depends on the accommodation (how far the object is from the eye).
- The relaxed lens = 20 diopter.
- In accommodative stage it can increase the refractive power up to 15d more, like in children (with time it becomes less).

Accommodation

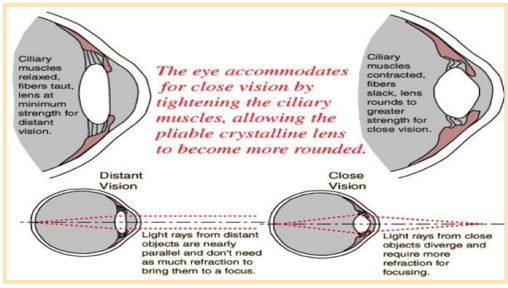
Emmetropic (normal) eye

Objects closer than 6 meters send divergent light that focus behind retina, adaptive mechanism of eye is to increase refractive power by accommodation.

Helm-holtz theory:

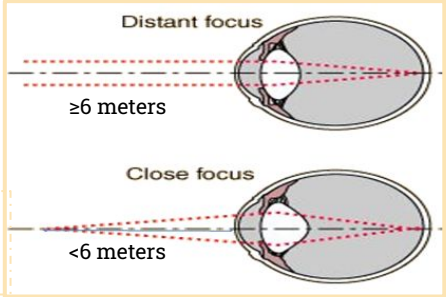
A. Viewing a NEAR object (< 6 meters):

- When the eye looks at a close object → contraction of ciliary muscle → decrease tension in zonule fibers → elasticity of lens capsule mold lens into a spherical shape anterior-posterior curvature (diameter) increase (become thicker) → greater dioptric power → divergent rays are focused on retina.
- Contraction of ciliary muscle is supplied by parasympathetic third nerve.
- Accommodation has **three** components:
  - **Change of lens shape.** Notice how the shape of the lens changes in relation to different distances (in near object we need a more powerful lens to maintain the point in the fovea so the lens becomes more thick)
  - **Miosis:** to allow as much light rays as possible to enter.
  - **Convergence:** contraction of medial recti muscle



B. Viewing a DISTANT object (≥ 6 meters):

- Relaxed situation: light rays are coming parallel.
- Accommodation is very relaxed.
- Eye power = 60D (40D + 20D).
- Note: imp
  - Power of accommodation is {(15 - age)/4} of the lens.
  - Accommodation is strong in children and decrease by age.
  - After prolonged reading there might be ciliary spasm associated headache.



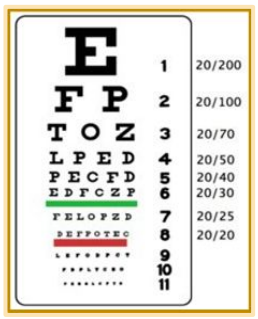
When the object gets closer. The lens thickened to reflect more otherwise it will fall behind the fovea.

Visual acuity (VA)

- VA is the vital sign of the eye and the first thing to do at the clinic with IOP (intraocular pressure).
- To assess the effect of pathology on VA.
- The effect of refractive error must be eliminated.
- Display of different –sized targets shown at a standard distance from the eye.
- Snellen chart.
- 20/20 ft = 6/6 m.

  - This is achieved by measuring: the patient's best spectacle correction or viewing the test chart through a pinhole.
  - Pinhole: optimal size 1.2mm, correct 3D of RE.
  - The pinhole is typically a glasses with a hole diameter of about 1 mm to 1.2mm (allows only 1 ray to pass), we tell the patient to focus his sight through the hole, the pinhole will cause muscle spasm, eliminate the mild refractive error of the patient (eliminate other confusing rays, only passes the rays going to fovea. Therefore, corrects for about three diopters!
  - When examining the patient you should examine each eye alone (and cover the other eye).

How to test the vision (test with closed eye)



❖ Central visual acuity:

- Display of different-sized targets shown at a standard distance from the eye (allen's & Snellen chart).
- Always start showing large letters (assuming everyone is blind) and go smaller till normal (the 20/20 line).
- 20/20 ft = 6/6 m (the distance where patient can read/distance where normal population read).
- Example: 20/200 = the patient can see at 20 ft only where the normal population see at 200 ft
- After measuring visual acuity do pinhole:
  - If improved 20/20 → means refractive error.
  - No improvement → other causes (could be cataract, glaucoma).
  - If improved but 20/80 → both refractive error + other causes.
  - In the first 2 months of life: do light objection test (if the baby objecting or closing the eye in response to light it means he/she is seeing).
  - From 2 months – 3 years: do follow and fixate test. At this age, babies will start to follow the objects, so bring a toy in front of them and do the test. (If following the toy → good vision).
    OR you can do (central= seeing centrally. Steady= no nystagmus. Maintained= baby is following object & after blinking he/she continues following the same object)
  - Age 3 – 6 years: Allen's chart.
  - More than 6 years: Snellen chart.
  - The vision maturation is an acquired skill for the brain, so when babies are first born they will be legally blind.
  - The axial length of the eye will grow quickly in the first 6 months. So, if anything stops the growing, they will have amblyopia (lazy eye) E.g: vitreous hemorrhage, congenital cataract.

How to test the vision (test with closed eye)

❖ Testing poor vision:

- If the patient is unable to read the largest letter <(20/200) (visual acuity) → move the patient closer e.g. 5/200.
- Then If the patient cannot read :(بالترتيب).
    1. Count fingers (CF) (how many fingers do you see? do it at 1 ft , 2 ft, etc).
    2. Hand motion (HM) (do u see my hand moving?).
    3. Light perception (LP) (shine the torch up, down, temporal, nasal "right and left').
    4. No light perception (NLP) (can't see any of the above = complete blindness).

- Legal blindness: if the vision in the best eye w/ best correction and providing is less than 20/200, this is the criteria used to determine eligibility for government disability benefits and which do not necessarily indicate a person's ability to function. In the US, the criteria for legal blindness are: Visual acuity of 20/200 or worse in the better eye with corrective lenses.
  * Visual field restriction to 20 degrees diameter or less (tunnel vision) in the better eye.
  Note that the definition of legal blindness differs from country to country and that the criteria listed above are for the US.

❖ Testing near visual acuity:

- It is done at a standard working distance ~ 30-40 cm.
- A variety of charts are available.

Emmetropia

the **normal** refractive state of an eye

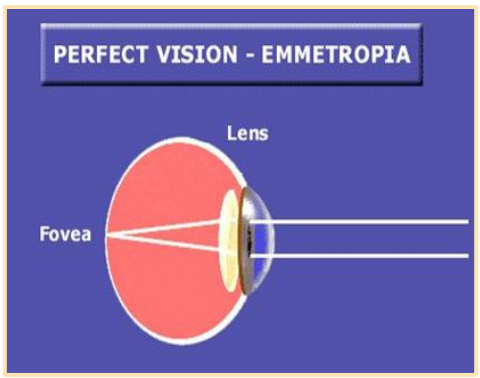
- Adequate correlation or **matching** between axial length "eye size" and refractive power of the eye.
- Rays of light from a distant object are brought to a pinpoint sharp focus on the retina (without accommodation).
- All refractive errors are some deviation from emmetropia.

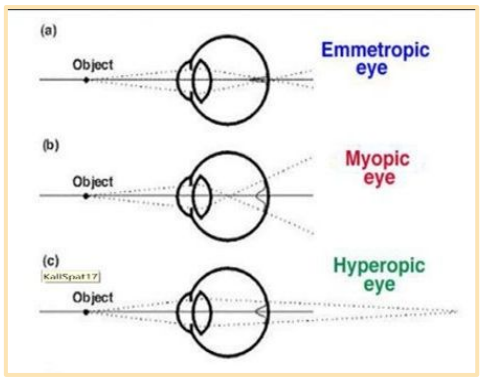
Refractive errors

"Ametropia"

- One of the causes of decreased visual acuity
- A **mismatch** between the refractive power (cornea and lens) and the focusing distance of the eye (axial length).
- Inability to see clearly is often caused by refractive errors.
- Three types of refractive errors (ametropia):
  - Myopia (**near**sightedness), extra power and long Axial length (image in front of the retina).
  - Hyperopia(**far**sightedness), less power and short Axial length (image behind the retina).
  - Astigmatism (irregular surface of cornea and lens).
- Emmetropia (normal).
- Ametropia = Refractive error. The 3 types.
- The gold standard of measuring refractive errors is retinoscope.

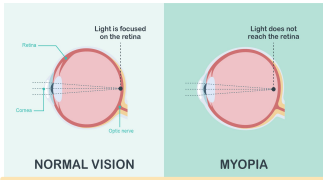
- When parallel rays of light from a distant object are brought to a focus on the retina with the eye at rest (i.e. not accommodating) the refractive state of the eye is known as emmetropia. Such an individual can see sharply in the distance without accommodation.
- **In ametropia** , parallel rays of light are not brought to a focus on the retina with the eye at rest. A change in refraction is required to achieve sharp vision.
- Ametropia may be divided into:
  - **Myopia (short-sightedness):** the optical power of the eye is too high (usually due to an elongated globe) and parallel rays of light are brought to a focus in front of the retina.
  - **Hypermetropia (long-sightedness):** the optical power is too low (usually because the eye is too short) and parallel rays of light converge towards a point behind the retina.
  - **Astigmatism:** the optical power of the cornea in different planes is not equal. Parallel rays of light passing through these different planes are brought to different points of focus.
  - All three types of ametropia can be corrected by spectacle lenses.These diverge the rays in myopia, converge the rays in hypermetropia, and correct for the non - spherical shape of the cornea in astigmatism.
  - It should be noted that in hypermetropia, accommodative effort will bring distant objects in to focus by increasing the power of the lens. This will use up the accommodative reserve for near objects.



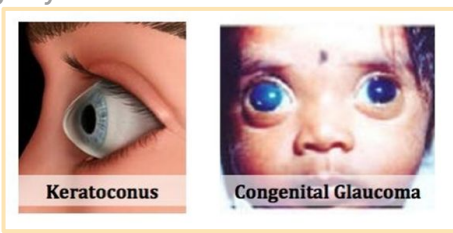


A. Point at the retina Matching between axial length (AL) & refractive power (RP).
B. Point in front of the retina * high RP & normal AL OR * normal RP & long AL.
C. Point behind the retina * low RP & normal AL OR * normal RP & short AL.

Myopia



- Rays of light from a distant object converge in front of the retina, causing a blurred image on the retina.
- Myopia can see close objects clearly, myopia is commonly known as "nearsightedness".
- Most prevalent among Asians (80-90%), followed by 25% of African Americans and 13% of Caucasians.
- Average age of onset: 8 up to 10 years and normally stops at 18-20 years (teenage years; can't see the board).
- Acquired myopia : come because of excessive + prolonged accommodation
- **Etiology:** not clear, genetic factors, acquired (excessive accommodation, near objects, aging).
  a. Japanese tend to have myopia more due to their crowded narrow surroundings which requires excessive accommodation.
- Myopia can be essential (primary) or secondary (increase in the refractive power of cornea or lens → become more curved).
- **Causes:**
  a. Excessive refractive power (refractive myopia). Eye is normal ; lens and cornea high refractive power
  b. Excessive long globe (axial myopia): **more common.** Huge "big" eye.



1. Increased refractive power:

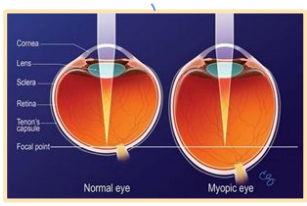
- **Change in lens nucleus or shape:** (cornea or lens is too curved)
  - Cataract due to growth
    (thick, hard, high density = high refractive power → induced myopia.)
  - The lens start growing more and more + refractive index increase = myopia.
  - Spherophakia: congenital anomaly where the lens is spherical in shape = more curvature = more myopia.
  - Diabetes.
    - Diabetic patients have both myopia and hyperopia depending on the level of the blood sugar.
      - ➢ High blood sugar → high sugar in aqueous humour → pull the fluid from the lens→ shrink of lens (flat) > hyperopia
      - ➢ Low blood sugar → fluid shift into lens → globular shape lens (swollen) → myopia.
      - ➢ Uncontrolled (fluctuations in blood sugar) lead to blurry vision.
- **Lens repositioning:**
  - Ciliary muscle shift e.g. miotics (medications).
    - Contraction of ciliary muscles → zonules relax → the lens become more curved induced myopia.
    - Lens movement e.g. anterior lens dislocation Trauma → lens moves forward → image will be in front → myopia.
- **Ciliary muscle tone:**
  - Excessive accommodation e.g. medical students, people who read a lot or use their phones for long period of time without stop.

- **Increase corneal power:**
  - Keratoconus (a collagen disease causing a cone shaped cornea → more curvature → induced myopia).
  - Congenital glaucoma (big globe +protrusion of cornea) congenital disease characterized by increase in IOP in babies.

Myopia

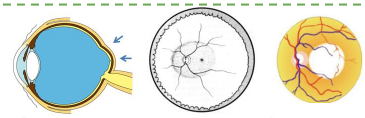
2. Increase axial length: more common.

- Congenital glaucoma, posterior staphyloma (bulging of posterior part of the eye).
- **Symptoms:**
  - Blurred distance vision.
  - Squint in an attempt to improve uncorrected visual acuity when gazing into the distance.
  - Headache due to eyestrain.
  - Amblyopia (كسل العين) – uncorrected myopia > **-5 D**.
  - Strabismus children
  - All types of refractive errors in the first 7 yrs of life will cause strabismus and amblyopia.
  - Children will have amblyopia and strabismus.



Extra

Congenital glaucoma



Posterior staphyloma is a localized bulge of posterior segment (arrows in left panel and outlined circular area in right panel). Staphyloma develops at around age 40 and causes more severe expansion of the posterior fundus including the macula and optic nerve.

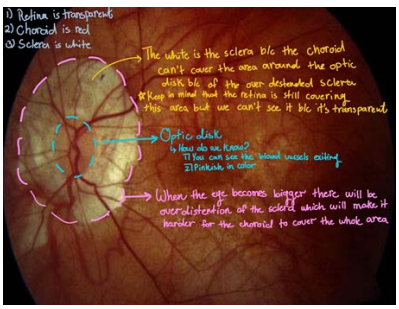
❖ Myopia forms:

1- Benign myopia (school age myopia):

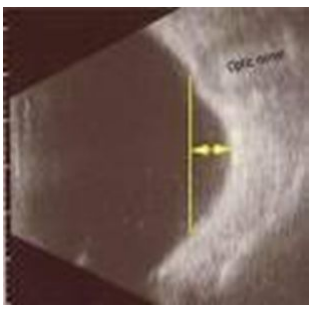
- Onset 8-12 years,
- Myopia increases until the child stops growing in height.
- Generally, tapers off at about 18- 20 years of age.

2- Progressive or malignant myopia (uncommon):

- Also called Degenerative or pathological myopia.
- Myopia increases rapidly each year and is associated with, fluidity of vitreous and chorioretinal change.
  - Pt is 25 year old with a refractive error -5 → 30 years old -7 → 35 years old -8.
  - Pathophysiology: due to abnormality in the wall of the sclera causing it to get more and more thinner → the eye gets bigger and bigger.
  - Pts are in risk of retinal detachment due to the break in retina and leaking of vitreous behind it



US showing posterior staphyloma (bulging of the posterior part of the eye).
-As the eye gets bigger, the sclera gets thin & weak which in return make the optic nerve able to push this are to the back.

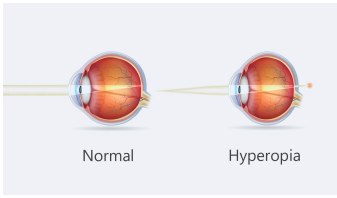


3- Morphologic eye changes in pathological myopia: (Axial Myopia):

- Only happens with axial myopia, no changes happen if benign myopia.

1. Deep anterior chamber.
2. Atrophy of ciliary muscle + iris atrophy due to excessive stretching.
3. Vitreous may collapse prematurely leading to opacification.
   - The eye is bigger (more space) and the vitreous (gel-like substance) will stay the same. Compensatory, The space will be partially filled with vitreous and the area where vitreous is unable to cover will be covered with aqueous humour causing them to mix in a process called "liquefaction" (causing the density of the vitreous to decrease).
4. Fundus changes:
   - Loss of pigment in RPE (retinal pigment epithelium), large disc and white crescent- shaped area on temporal side, RPE atrophy in macular area, posterior staphyloma, and retinal degeneration → hole → increase risk of RRD (rhegmatogenous retinal detachment) → vision loss.
   - One of the complications of axial myopia is retinal detachment.
   - Correction of Myopia: (negative) concave lenses. posterior staphyloma.

Hyperopia



- Parallel rays converge at a focal point posterior to the retina.
- Etiology: not clear, inherited, trauma may cause dislocation of the lens.
- Rays of light from a distant object now focus behind the retina.
- Hyperopic people must accommodate when gazing into distance to bring focal point on to the retina.
- However, this reduces their accommodative reserve when they want to view close objects. This means their distance vision is generally better than their near vision, hence the term "long- sightedness".

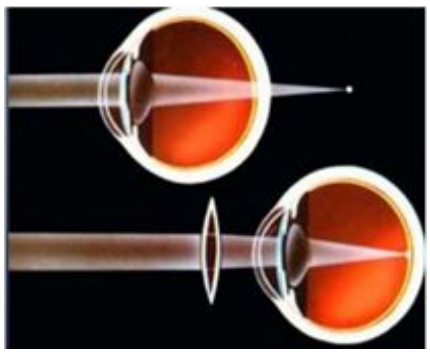
❖ Causes:

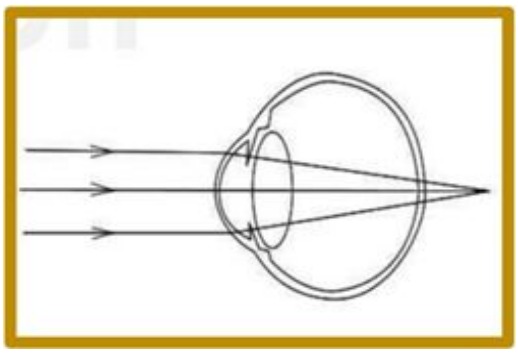
- Excessive short globe (decreased effective axial length): (small eye).
  - Axial hyperopia.
  - More common.
  - Retina pushed forward: tumor, orbital mass.
- Insufficient (decreased) refractive power (refractive hyperopia).
  - Absent (aphakia) "lens came out from trauma or surgical removal = loss of 20 diopter" or posteriorly repositioned lens.
  - Weak accommodation: trauma (ciliary muscle), marijuana "marijuana weakens ciliary muscles after using it (induced hyperopia)" relaxation of accomodation.

❖ Symptoms:

- Visual acuity at near tends to blur relatively early "inability to read fine print".
- Asthenopic symptoms: eye pain/ strain, headache in frontal region.
  - Especially after reading/using the phone they require more accommodation.
- Accommodative esotropia*: because accommodation is linked to convergence leading to esotropia (ET).
- Amblyopia* – uncorrected hyperopia > +5D.
- Strabismus.
- Children will have amblyopia and strabismus.
- Correction of hyperopia: (positive) convex lenses.

Mass pushing the retina forward which will make the axial length shorter >induce hyperopia.





Rays of light from a distant object focus behind the retina

Astigmatism

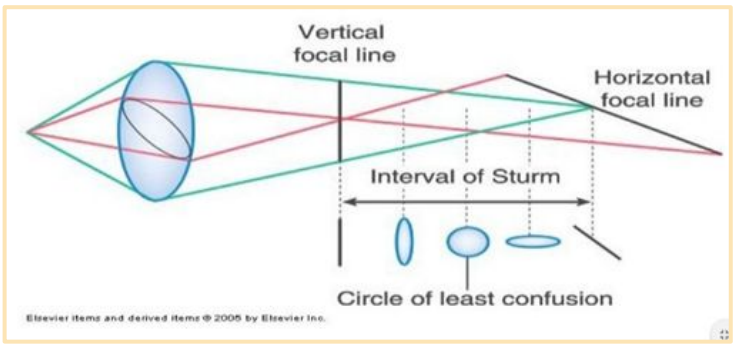
- Astigmatism is a common and generally treatable imperfection in the curvature of the eye that causes blurred distance and near vision.
  - The essential cause is the eye shape> you may describe it to the patient as "your eye is shaped as a rugby ball instead of a football".
- Cornea is usually shaped like half a football. In these eyes there will be no astigmatism.
- Astigmatism occurs when either the cornea or the lens, has mismatched curves. Instead of having one curve like a round ball, the surface is egg shaped. This causes blurred vision at all distances> will lead to either myopia or hyperopia.
- In astigmatism, surface of cornea is not homogenous. Usually it is congenital.
- Parallel rays come to focus in 2 focal lines (the vertical line will give a point, and the horizontal line will give another point) rather than a single focal point.
- Etiology: hereditary.
- Cause: refractive media is not spherical → refract differently along one meridian than along meridian perpendicular to it → 2 focal.

This ball will give you only one point > either ON the retina, or in front of it, or behind it.

This ball will give you 2 points one by the horizontal surface and the other by the vertical surface.

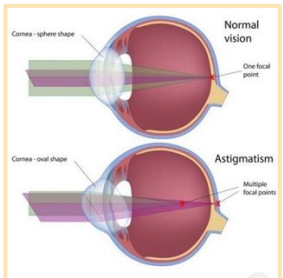
❖ 5 types:

1. **Simple Myopic Astigmatism:** one before the retina, and one on the retina
2. **Simple Hyperopic Astigmatism:** one on the retina and another behind the retina.
3. **Compound Myopic Astigmatism:** both of which are before the retina but at two different locations before the retina.
4. **Compound Hyperopic Astigmatism:** both behind the retina but at different virtual locations.
5. **Mixed Astigmatism:** one is before the retina and the other is behind the retina.
   - It's the worst in the quality of vision.



❖ Causes of astigmatism:

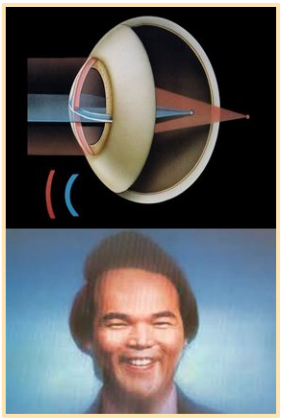
- **Corneal causes:** (majority)
  - Simple corneal astigmatism this is the eye shape it is essential not a secondary cause.
  - Keratoconus causes Myopic astigmatism.
  - Masses e.g. **lid tumor** (induced astigmatism> weight of tumor press on the cornea > remove the tumor.
  - Ptosis could be congenital.
- **Lenticular causes:**
  - Lens dislocation.
  - Lenticonus.



Extra

Astigmatism

- Notice the horizontal surface gives the blue rays.
- The vertical surface gives the red rays.
- This is called regular astigmatism

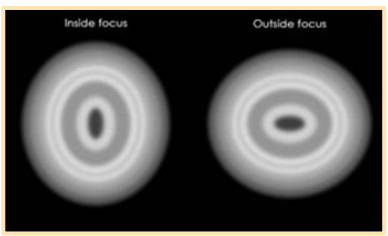
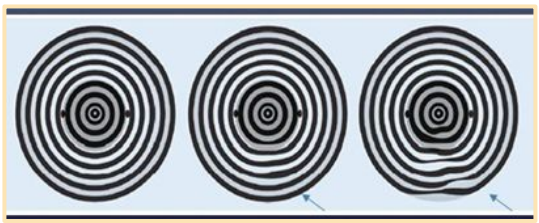


- This is a distorted image.
- The man doesn't look like this in reality but this is how the patient sees him.

Symptoms:

Asthenopic symptoms (headache & eye pain)	Blurred vision	Distortion of vision	Head tilting and turning	Uncorrected astigmatism > 1.5 Diopters might lead to amblyopia in children.

Classification:

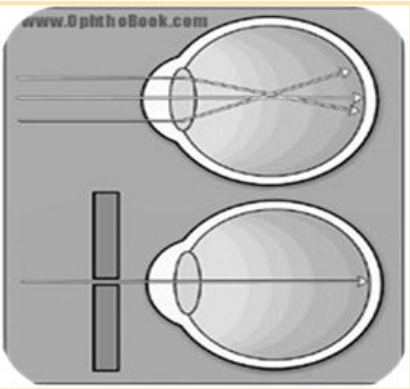
Regular astigmatism (2 meridians)	Irregular astigmatism (different meridians > 2)
• Power and orientation of principal meridians are constant. The principal meridians are 90 degrees apart (perpendicular to each other). • With the rule astigmatism, Against the rule astigmatism, oblique astigma	• Power and orientation of principal meridians change across the pupil. The principal meridians are not perpendicular. • Trauma, sutures> scar in cornea> irregular astigmatism • (fixed by hard contact lens pressing on the cornea regular) • Correction of astigmatism: cylindrical lenses.
	

Astigmatism

❖ How To diagnose a refractive error?

1. Measure the visual acuity by the chart.
2. Pin hole> either the patient will improve (it means it is a refractive error), or he will not improve (it is something else like cataract).
3. Measure the refractive error (3 types) by Retinoscope, but now there are computerised machines> but when there is a complicated case we use the old gold standard (the retinoscope).

This is how we measure the refractive error, by the retinoscope and using these lenses.



Why pt with a refractive error will improve by using the pin hole? The holes will let only the rays that stop exactly on the fovea to pass through , and prevent the others.

Presbyopia

- Physiological loss of accommodation in advancing age.
- Deposition of insoluble proteins in the lens with advancing age leads to progressive decrease in the elasticity of the lens and decrease accommodation.

"gradual loss of your eyes' ability to focus on nearby objects."

- Around 40 years of age, accommodation becomes less than 3D. Reading is possible at 40-50 cm → difficulty reading fine print, headache, visual fatigue.
- Patients with myopia and later have presbyopia, they would remove the glasses to see near objects. While Hyperopic patients need to use another glasses for reading or can have one glasses with the lens split into upper half for far objects and lower half with different power for reading.
- With aging zonules relaxes, Lens gets dry.
- The difference between presbyopia and hyperopia is that in presbyopia the zoom function is lost while in hyperopia its still intact".
- His vision is 20/20 but still needs glasses, Because he lost the flexibility of his lenses and it become more rigid with advanced age.
- Correction of presbyopia: convex lenses.

Anisometropia:

- A difference in refractive error between the two eyes.
- Individuals can tolerate up to 2-3 Diopters of anisometropia before becoming symptomatic.
- Refractive correction often leads to different image sizes on the 2 retinas (aniseikonia).
- Aniseikonia depends on degree of refractive anomaly and type of correction.
- Anisometropia is the condition in which the two eyes have unequal refractive power. Generally, a difference in power of two diopters or more is the accepted threshold to label the condition anisometropia.
- More than 3 diopters difference if not detected in pediatrics and corrected it can cause unilateral amblyopia "in the weaker eye".
- An ocular condition in which the image of an object in one eye differs in size or shape from the image of the same object in the other eye.

❖ Causes:

- Correction of a refractive error.
- Anisometropia.
- Antimetropia (being myopic (nearsighted) in one eye and hyperopic (farsighted) in the other).
- Meridional aniseikonia occurs when these refractive differences only occur in one meridian (see astigmatism).
- Refractive surgery.

If the difference between 2 eyes : (D = Doppler)

- Less than 3D > it is ok to wear glasses.
- If more than 3 but less than 7D > Patient can't tolerate glasses but can use contact lenses
- More than 7D > refractive surgery .

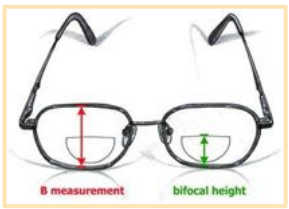
Correction of refractive errors

- Far point: A point on the visual axis conjugate to the retina when accommodation is completely relaxed.
- Placing the imaging of the object at far point will cause a clear image of that object to be relayed to the retina.
- Use correcting lenses to form an image of infinity at the far point , correcting the eye for distance

1 Types of optical correction

❖ Spectacle lenses

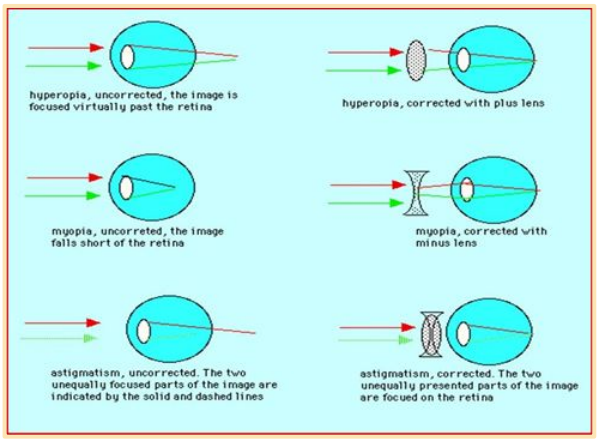
- Monofocal lenses (one power): spherical lenses (for myopia and hyperopia) & cylindrical lenses (for regular astigmatism combines the minus with plus).
- Multifocal lenses: the upper and lower parts have different powers for patients with: presbyopia + myopia/hyperopia. (hyperopia since 18 YO. Now 45 YO can not read).
- In hyperopia the power of the eye is decreased → correct with convex, plus lens.
- In myopia the power of the eye is increased → correct with biconcave, minus lens.
- In astigmatism two unequally focused parts → plus & minus lenses on top of each other (cylindrical).



This is multifocal lens
اللي بالاخضر الجزء الصغير
يخدم بالقراءة والكبير بالاحمر
يخدم النظر للبعيد

❖ Contact lenses

- Higher quality of optical image and less influence on the size of retinal image than spectacle lenses.
- **Indication:**
  - Cosmetic, athletic activities, occupational, irregular corneal astigmatism, high anisometropia, and corneal disease.
- **Disadvantages:**
  - Careful daily cleaning and disinfection & expense.
- **Complications:**
  - Infectious keratitis, giant papillary conjunctivitis, corneal vascularization, and severe chronic conjunct



In hyperopia the lens is weak (pic is behind) so we give it more power by using the convex lens.

In myopia the lense is strong I need the weaken it by using biconcave lens..

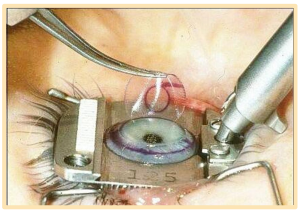
In astigmatism I have 2 points so I need to use 2 lenses (one plus, one minus) to correct it, so how?
we combine them (the minus with the plus) by using cylindrical lens.

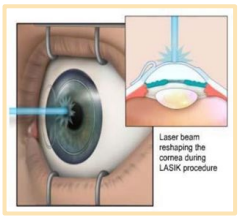
Correction of refractive errors

2 Surgical correction

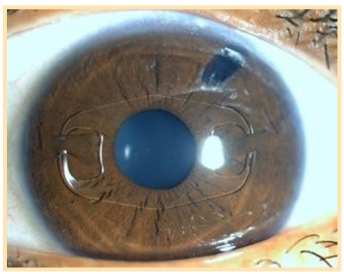
❖ Kerato-refractive surgery (work on the cornea. Doesn't correct high power)

- Refractive surgery – flattens corneal surface (more successful because it's easier to flatten than to make it more convex) for myopia or increases its curvature in Hyperopia.
- Focus the laser on the stroma to reduce the power of the cornea in the center (myopia).
- Improves unaided visual acuity but may have complications.
  - Examples: PRK, LASIK, LASEK, EPILASIK.
  - LASEKS: laser assisted stromal in-situ.
  - In PRK we focus the laser on the corneal surface to remove the epithelium only without the stroma (we don't make a cut).
  - Patient is more than 40 we can do it , but still might need glasses to read.





❖ Intraocular surgery (For high power)



- Give best optical correction for aphakia.
- Avoid significant magnification and distortion caused by spectacle lenses.
- Clear lens extraction (with or without IOL).
- Phakic IOL (ICL) (In front of lens or attached to iris).
  - Phakic IOL (intraocular lenses): lenses made of plastic or silicone that are implanted into the eye permanently to reduce a person's need for glasses or contact lenses.
- One of the side effects of the intraocular lens procedure => loss of accommodation.

Notes: Extra

Photo refractive keratectomy (PRK):

(no flap.We just remove the epithelium apply laser then the epithelium will grow)

Advantages: safer on the long run

Disadvantages: severe pain for 1 week, blurred vision for 2 3 weeks

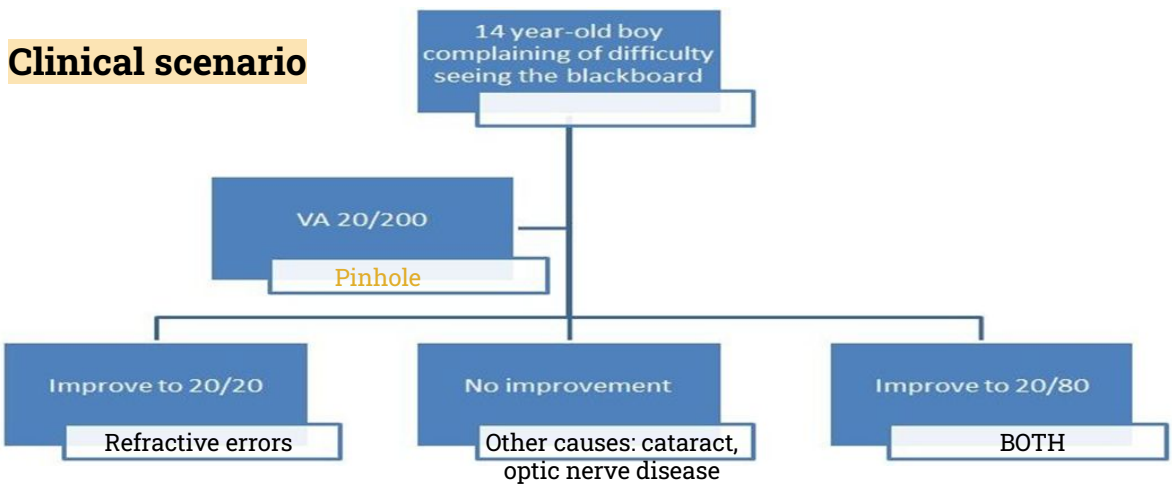
laser-assisted-in-situ keratomileusis (LASIK)

(thin flap)

Advantages: immediate 20/20 vision, no pain, good visual rehabilitation, can correct high numbers (up to – 8)

Disadvantages: severe trauma the flap can fall down

Clinical scenario



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