UNIVERSITATEA DE STAT DE MEDICINĂ ȘI FARMACIE
„NICOLAE TESTEMIȚANU” DIN REPUBLICA MOLDOVA

Catedra Oftalmologie

Clinical Refraction and Accomodation

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Aim

- This unit will introduce you to the study of optics, how light focuses in the eye, and what happens when the eye fails to focus light correctly

Objective

- Identify and name the part of the eye optical system
- Describe how these parts work to focus the light and form a visual image
- Define refractive error and list the different types of refractive errors.
- Explain how the eye can change its focus from distant objects to close and why the ability to accommodate decrease as people get older

- **The change of direction when light passes at an angle from one optical medium to another is called ...**
  a. absorption
  b. reflection
  c. refractive index
  d. divergence
  e. refraction

A prism ...

a. bends light towards the base and the image appears towards the apex

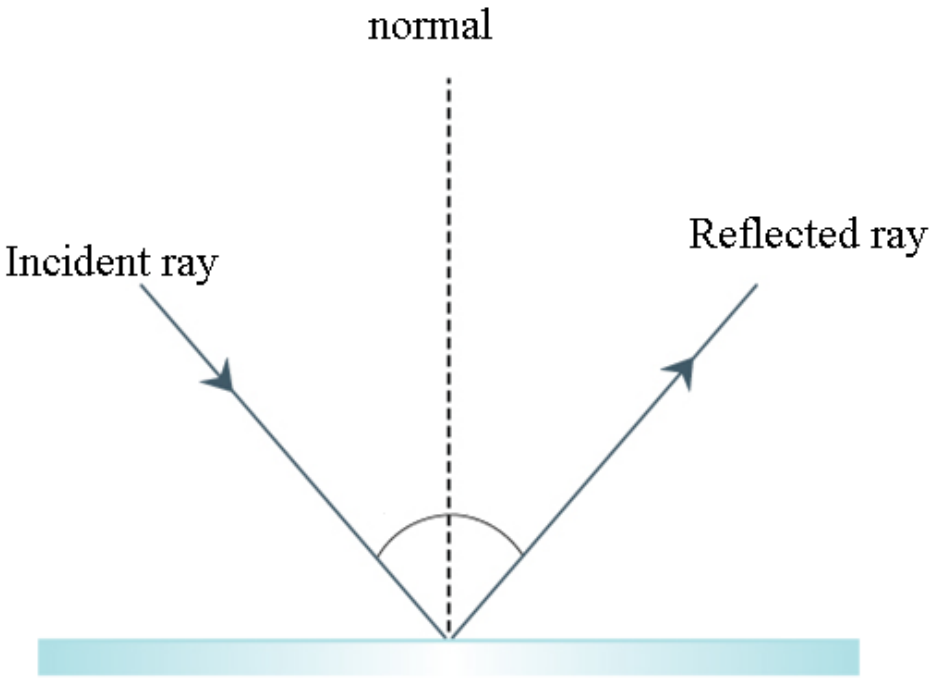
b. bends light towards the apex and the image appears towards the base

c. bends light towards the base and the image appears towards the base

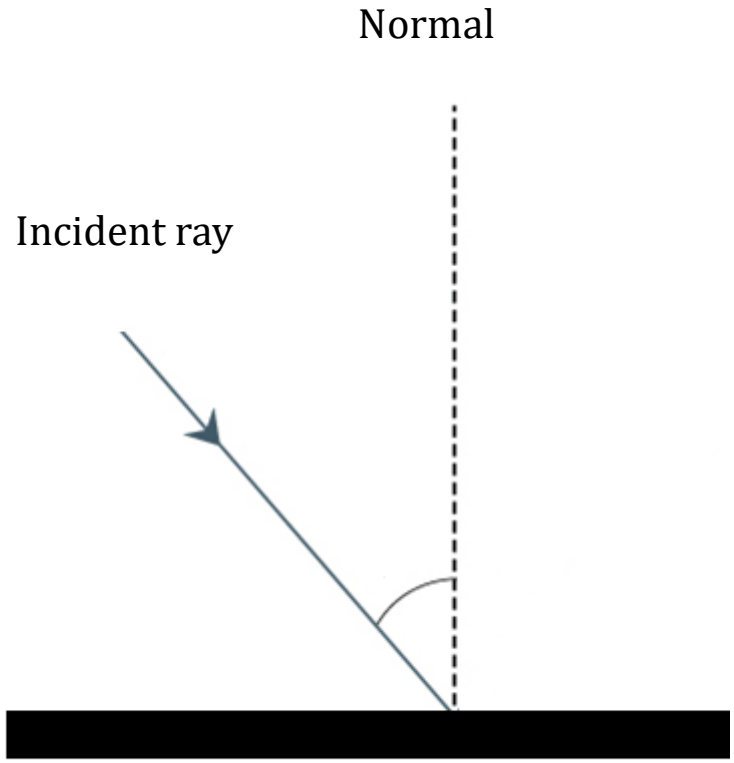
d. diverges light

e. converges light

How light travels



Reflection



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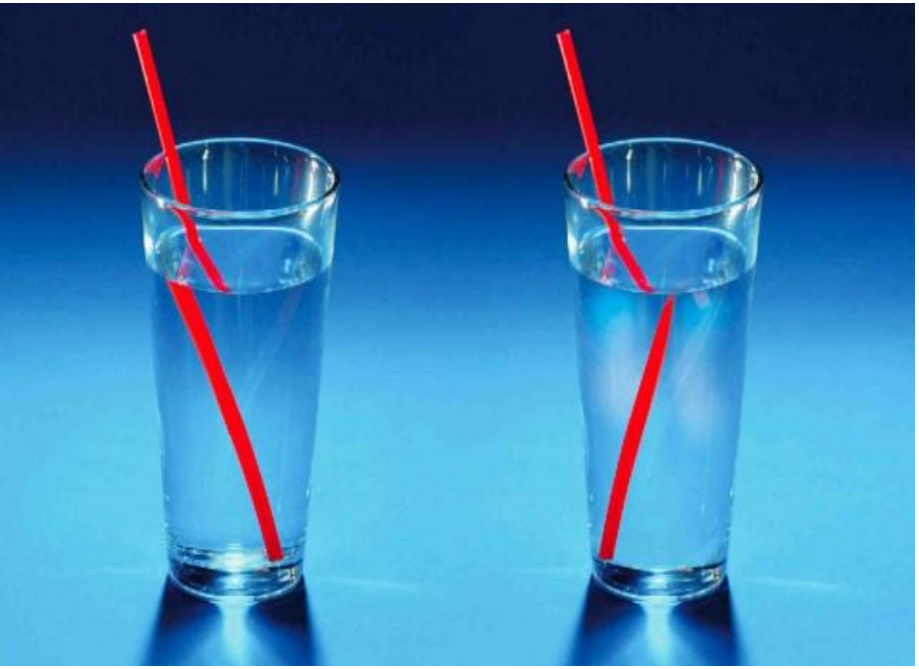
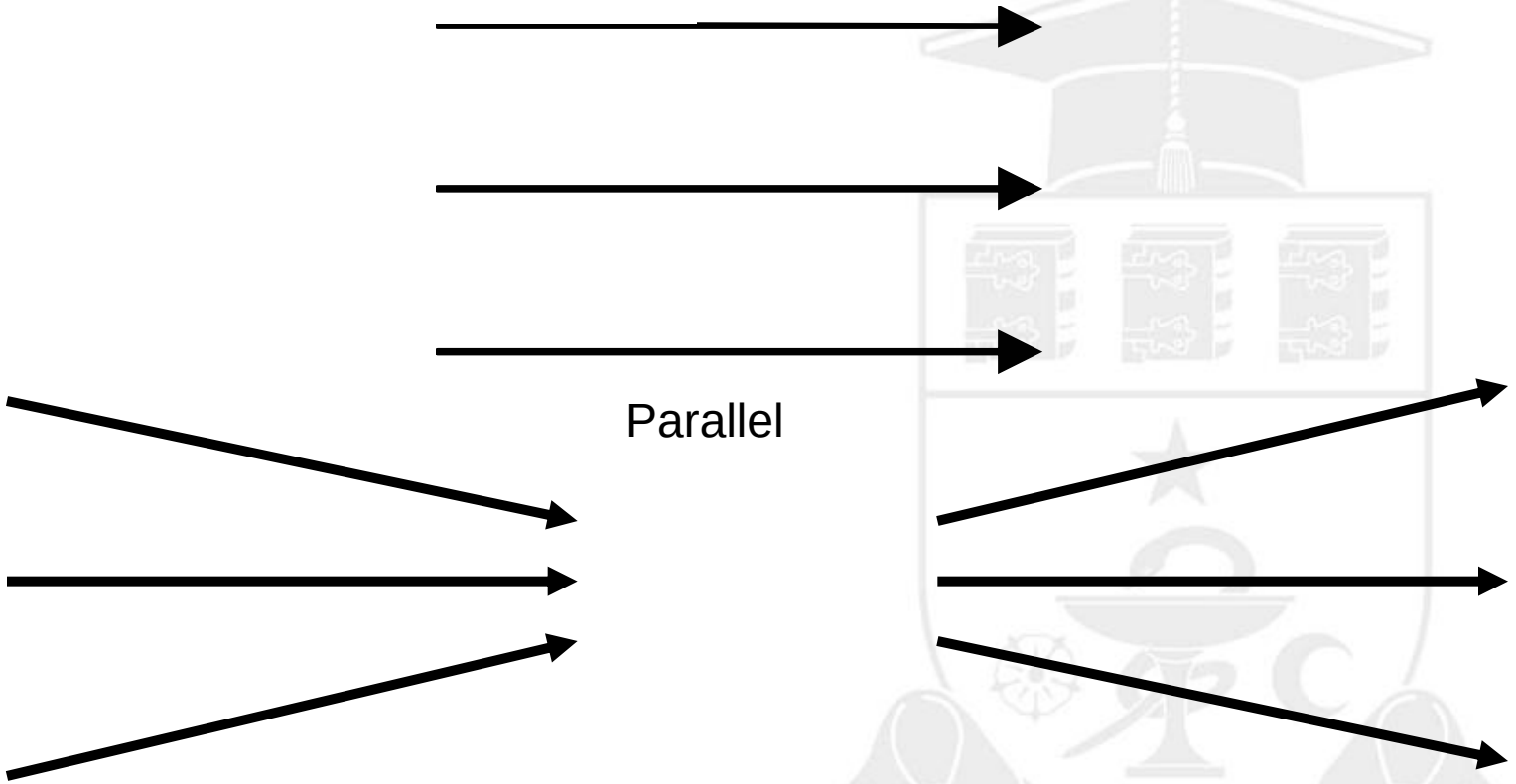
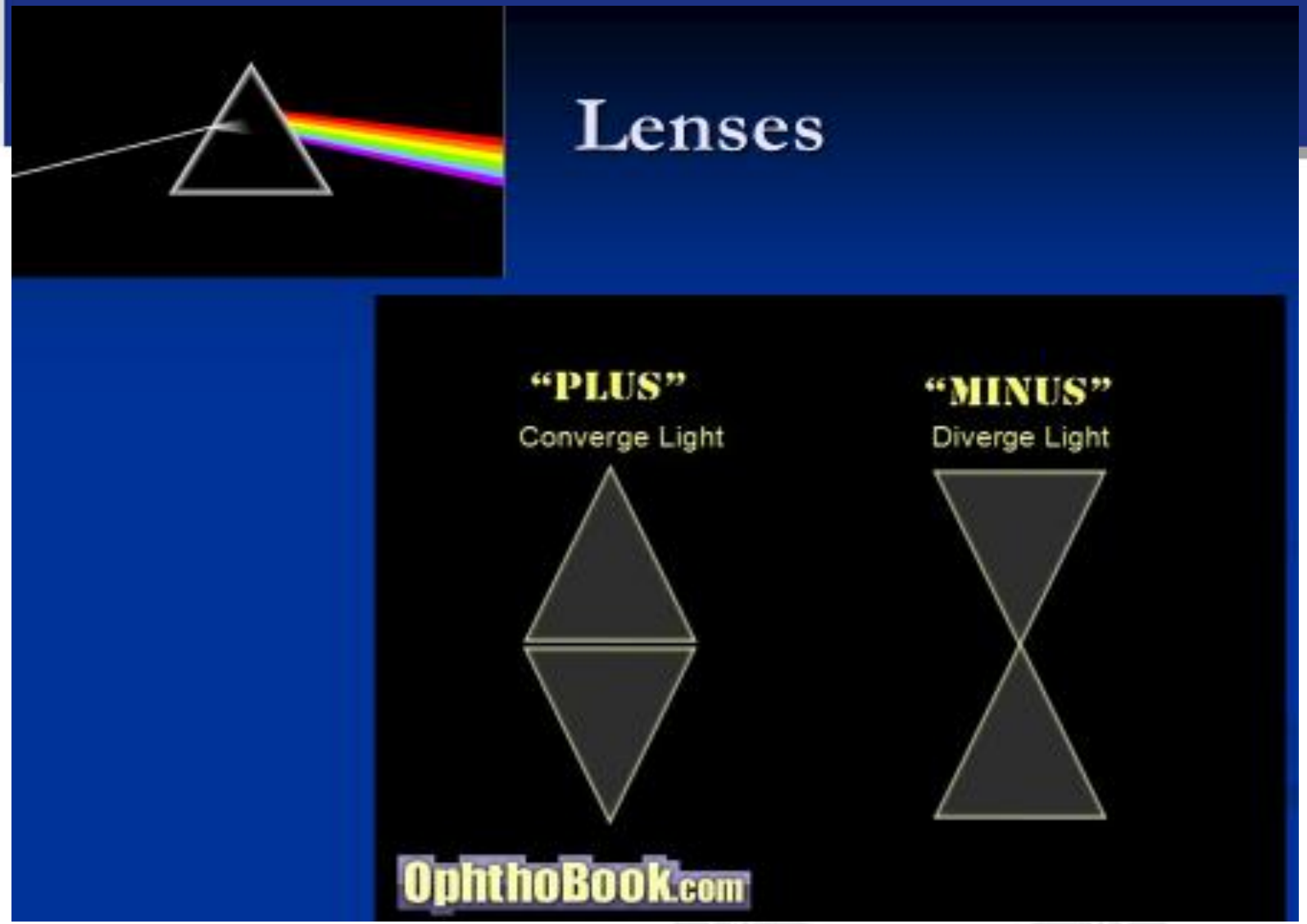


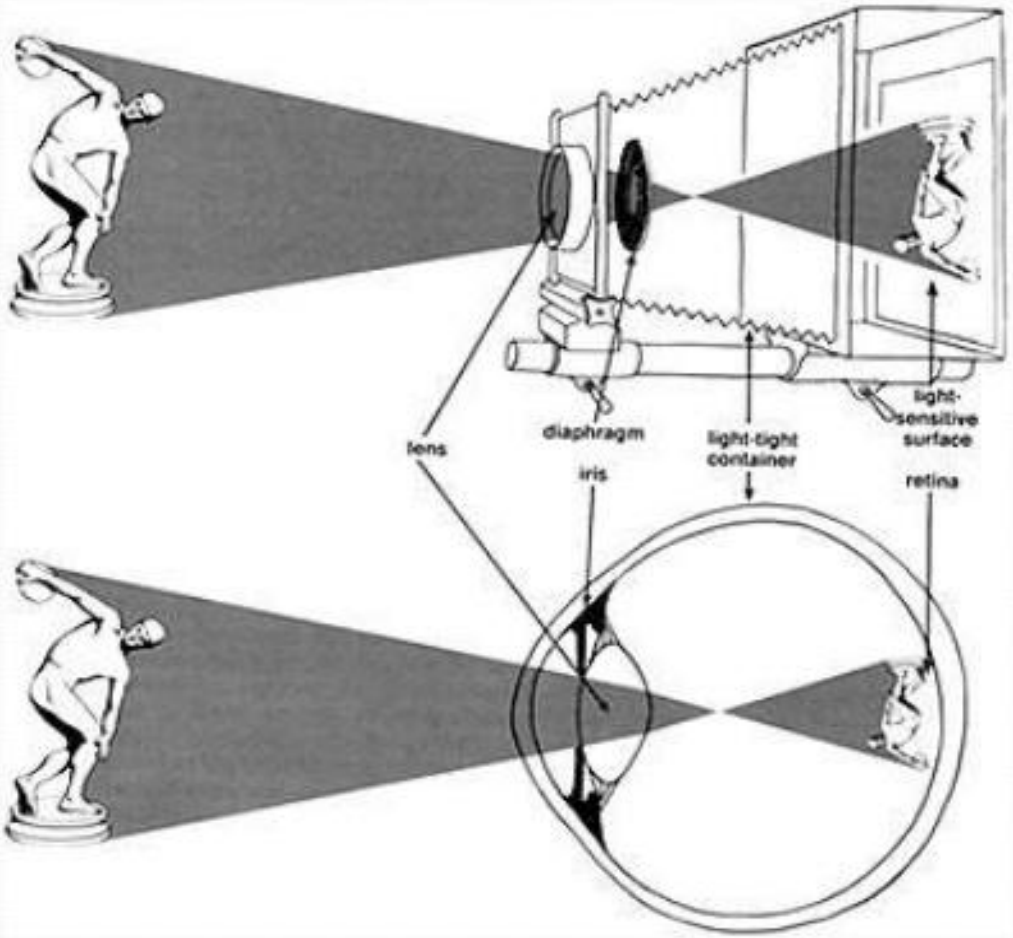
How light travels





Could You tell me haw the light rays travel through these lenses?

Eye as a camera



Eyelids- shutter

Cornea- focusing system
Lens- focusing system

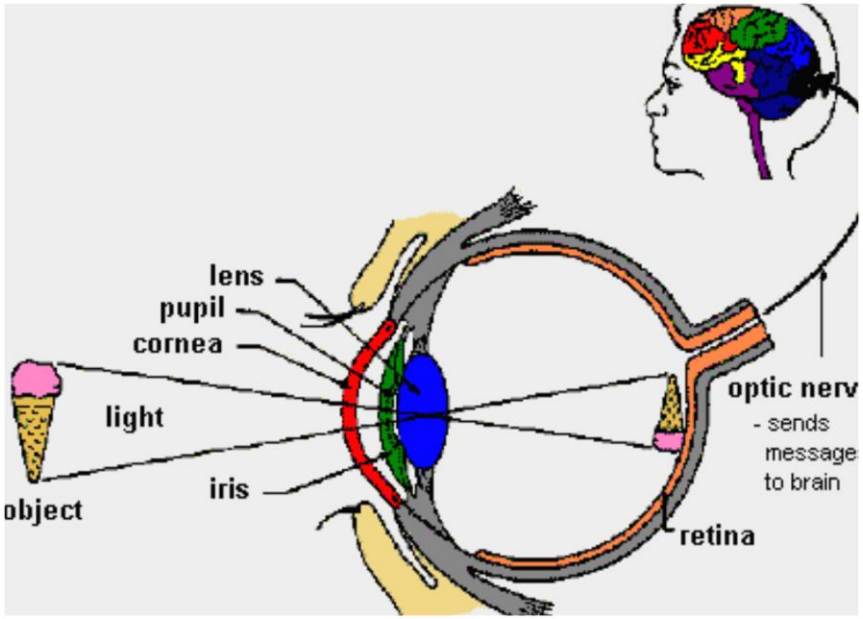
Iris- diaphragm

Choroid- dark chamber

Retina-light sensitive film

How the Eye Sees

- light rays that reflect off objects ⇒ travel through the eye's optical system changes direction - **refract** ⇒ the retina converts light rays into impulses;
- sent through the optic nerve to your brain, where they are recognized as images.



Refractive component of the eye?

The eye requires about 60 dioptres of power to focus the light from a distant object precisely onto the retina.

Conclusion:

- ***phisical refraction*** - the traiectory of the rays through an optical system

- ***clinical refraction*** - the position of the focus according to the retina.

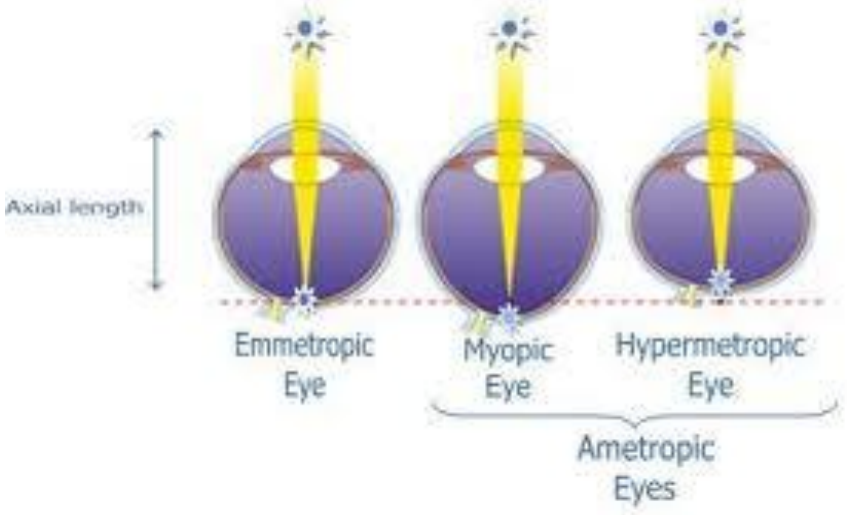
The refractive state of the eye (nonaccommodating) can be considered in two different ways:

1. EMMETROPIA is the refractive state in which parallel rays of light from a distant object are brought to focus on the retina. The far point of the emmetropic eye is at infinity.

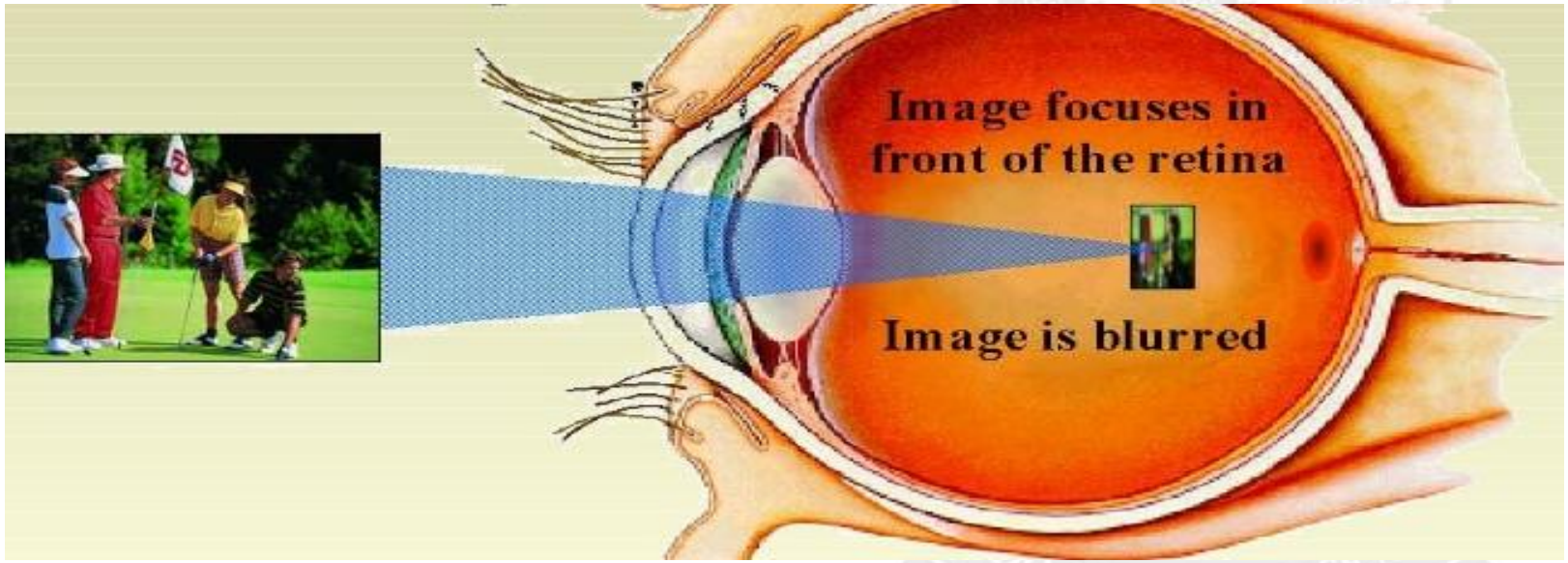
2. AMETROPIA

- **myopia**
- **hyperopia**

(the total power of the eye is abnormal: exessive in myopia (M) and inadequate in HM)



Myopia – the optical power of the eye is too high and parallel rays of light focus in front of the retina.



MYOPIA – WHY?

- axial myopia -the eyeball is too large
- refractive myopia (refractive power of lens or cornea – too strong)
- Curvature Myopia (Increase of surfaces of cornea or the lens)

Myopia symptoms:

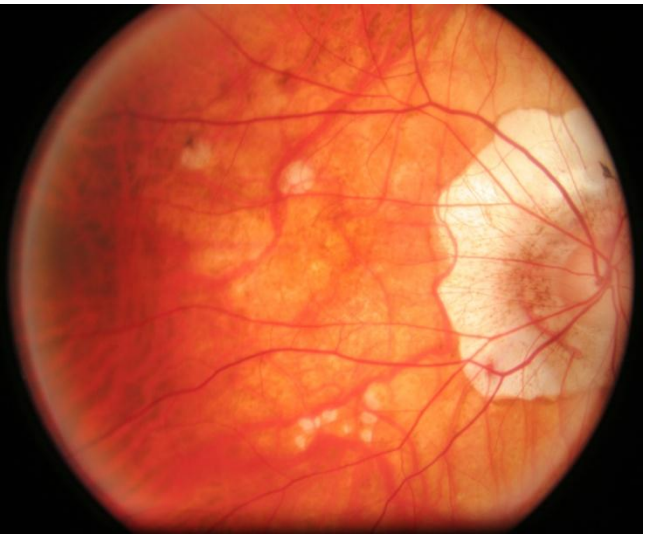
- Poor distant vision
- Squinting of eyes
- Keeping books close to face
- Night blindness

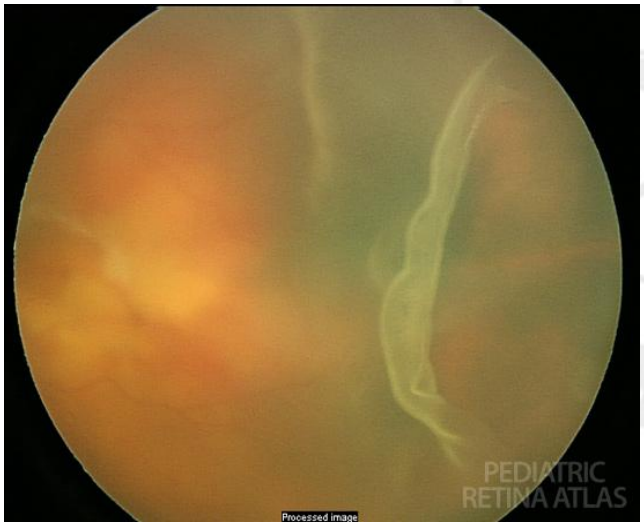
There are 3 degree of myopia:

- I degree — from -0,5 to -3,0D
- II degree — -3,25D – -6D
- III degree — - 6,25 – ↑

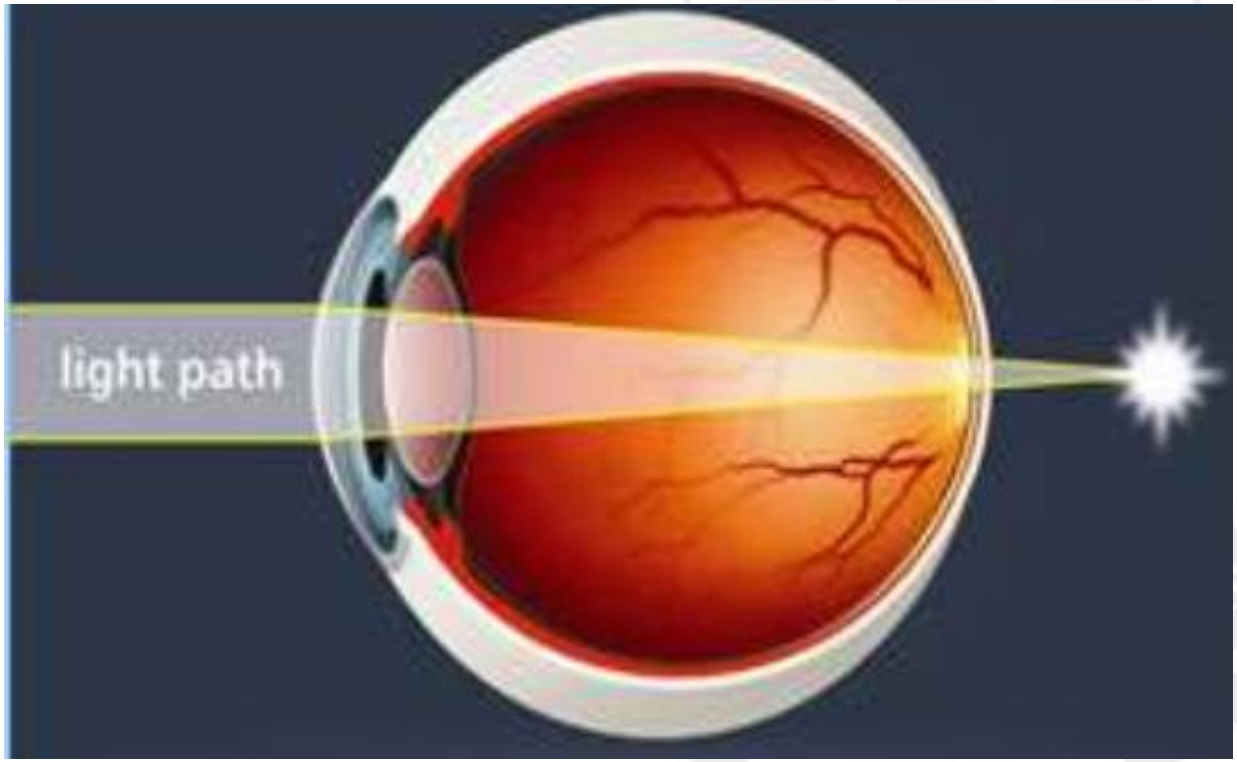
If myopia becomes malignant (progressive) there are also profound changes in the eye:

- Cataract
- primary open angle glaucoma
- retinal detachments
- Vitreoretinal degenerative changes





Hypermetropia – the optical power is too low and the main focus is behind the retina.



Symptoms:

- Blurring of vision for close work
- Symptoms depends of age and degree of HM
- Asthenopic symptoms

HIPERMETROPIA - WHY ?

- axial HM (the eyeball may be too small for the refractive power of the cornea and lens)
- refractive HM (due to changes in the refractive power of lens or cornea – is too low).
- Curvatural HM (flatter cornea)
- Positional
- Aphakia

Complications:

- Reccurent blefaritis and salasion
- Amblyopia
- Convergent squint

There are 3 degree of hypermetropia:

- I degree +0,5 – +3,0D
- II degree +3,25D – +6,0D
- III degree + 6,25 – ↑

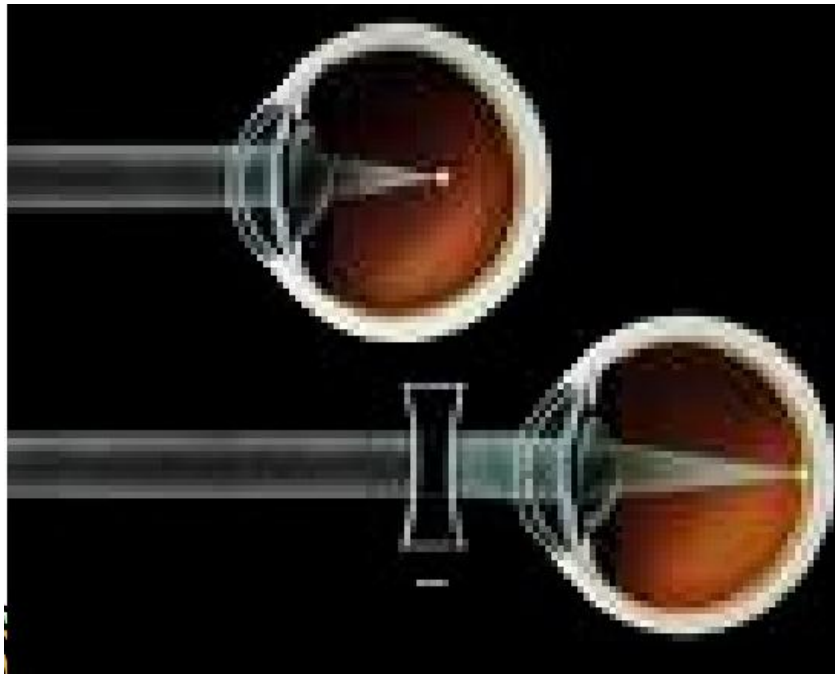
Refraction and growth of the eye

Could you tell me which refraction should have a newborn?

Myopia and Hypermetropia management

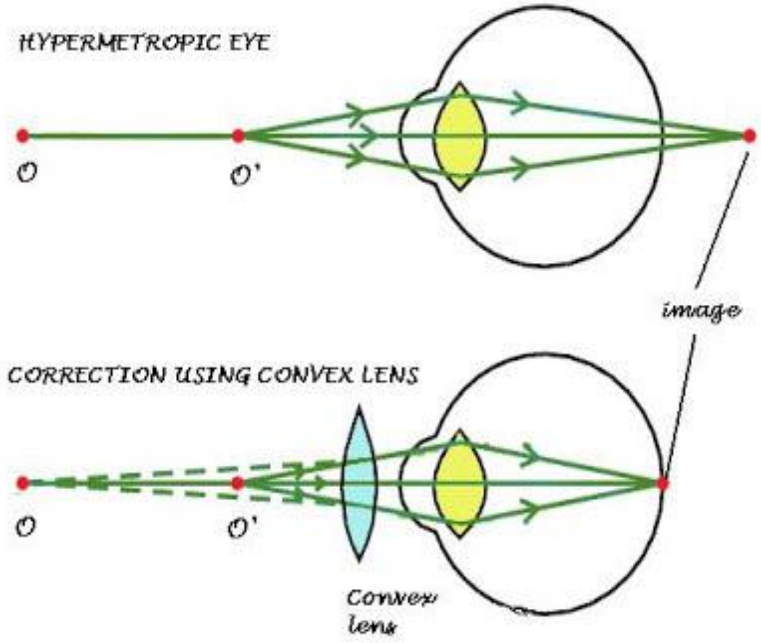
Myopia treatment

- Divergent lenses : minus (-)
- Avoid Overcorrection!!!



Hypermetropia treatment:

- Convergent lenses: plus (+)



Sometimes people have a significant difference between the refractive errors of the eyes.
This is called anisometropia.

Accommodation

– is the mechanism by which the eye changes (*increases*) refractive power in order to focus objects at different distance

Accomodative effort occurs when:

1. the ciliary muscle contracts
2. the zonule fibers relax (in response to parasympathetic innervation).
3. increase in lens convexity (primarily the front surface).

ANOMALIES OF ACCOMMODATION

- Physiological – PRESBYOPIA
- Pathological:
  a) Spasm of accommodation
  b) Paralysis of accommodation

The Answer?

Presbiopia

The physiologic loss of accommodation in the eyes in advancing age.

This occurs earlier in HM than in myopes.

Causes:

age related changes in the lens:
- decrease in elasticity of lens capsule and hardness of lens substance
- age related decline in ciliary muscle power

Optical treatment:

- glasses (convergent (+ lenses))
- contact lenses

- 40 years +1,0D (+0,5)
- 50 years +1,0D -+2,0D
- 60 years +2,0D -+3,0D
- 70 years +3,0D -+4,0D

- This correction is added to the distant optical correction of the patients.

Spasm of accommodation

a condition in which the ciliary muscle of the eye remains in a constant state of contraction.

- *Causes* - drug induced after use of miotics

  - uncorrected hyperopia, excessive near work is done with bad illumination, bad position

- *Simptoms:* Blurred vision at DISTANCE after performing near visual tasks .
- *Treatment:* Relaxation of ciliary muscles with atropine

Paralysis of accommodation

- *Causes:*

1) drug induced: atropine, tropicamid
2) traumatic
3) muchrooms poisoning
4) CNS infections

- *Simptoms:* NEAR visual acuity is blured
  photophobia
- *Treatment:*
  - *self recovery in drug induced paralasis*
  - *convex lenses for near vision*

DIAGNOSIS of refractive errors

1. *Subjectiv methods:*
   - ✓ Trial lenses. The patient look through a variety of lenses until an appropriate optical correction is determined.
2. *Objective methods:*
   a) Retinoscop
   b) automated refractor

Conclusions

- The main optical structures of the eye are: cornea and lens
- The main types of refractive errors
  - myopia,
  - hypermetropia
  - presbiopia
  - astigmatism
- Accommodation is a mechanism which allow us to see objects situated at different distances

References:

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