

Refractive media of eye

Light

Light: radiant energy of electromagnetic waves
We see wavelengths of (400-750) nm
Velocity in air 300,000 km/sec
Velocity in transparent solids 200,000 km/sec

Light physics:

When light strikes a surface it's either:
Reflected or **transmitted** (with or without *refraction*)

Refractive index (RI):

ratio of light **velocity in air** to light **velocity in medium**
(1.0 for air) (1.5 for glass) (1.3 for water)

Refractive power of lens

The power of a lens is measured in **DIOPTERS**

Example: 0.1 focal length lens is $1/0.1 = 10$ diopters

Types of lenses

1) **convex / Concave**

2) **spherical / cylindrical**

Refractive media of eye (4)

4 but Only (2) have refractive powers (diopters)

- Cornea (+39) diopters RI: 1.38
- Aqueous humor (none) RI: 1.33
- Lens (+20) diopters RI: 1.40
- Vitreous humor (none) RI: 1.34

Outer layer of the eye

Contains **cornea & sclera**

Cornea

cornea: (anterior)

- transparent $\frac{1}{6}$ of outer eyeball
- 11 mm diameter & 1.0 mm thick
- It has **5 layers** (endothelium most important)

corneal metabolism

- Maintains **dehydration & transparency** of cornea

corneal metabolism sources

- Tears give O₂
- Corneo-scleral junction O₂ & glucose
- Aqueous humor glucose

corneal transparency causes

- **Anatomic factors:**
 - 1) regular arrangement of the epithelial cells & lamellae
 - 2) no blood vessels or myelinated nerve fibers
- **Physical factors:**
 - 1) Refractive index of corneal layers *is the same*
 - 2) pumps in endothelial cells cause corneal dehydration

corneal pumps

- **osmotic pump** (*passive*)
Aqueous humor & tears remove water from cornea cause **they are hypertonic**
- **metabolic pump** (*active*)
Na⁺ pump in endothelium use energy from corneal metabolism to pump Na⁺ from cornea to Aqueous humor (Water follows Na⁺)

corneal functions

- Allow light pass to eye
cause transparent
- Help form sharp clear images on retina
Cause of it's regular curvature
- **Powerful convex lens**
(39~43 Diopters) (70% Dioptric power)
- **Protection of inner eyeball structures by:**
 - its fibrous structure
 - absorbing UV rays on eye (protect retina)
 - Corneal reflex (**abnormal touch result in Bilateral blinking**)

Corneal reflex pathway is
Trigeminal nerve -> pontine center -> facial nerve

Refractive media of eye

Sclera

Sclera:

- Posterior $\frac{5}{6}$ of outer eyeball
- Anteriorly covered by **conjunctiva**
- **White** in adults, **Blue** in young
- **Opaque** due to **fibers irregularity**

corneal functions

- Protect inner eye structures
- Gives attachments to external ocular muscles

Aqueous humour

Aqueous humour:

- Transparent colorless alkaline fluid
- Fills anterior & posterior eye chambers

Aqueous humour formation:

Formed by Facilitated diffusion & active transport
From **ciliary epithelium**
(Na by active transport), (Cl, HCO₃ H₂O follow Na⁺)
Rate 1-2 μ L/min

Aqueous humour functions

- Refractive eye media
- Nourish the avascular cornea/lens
- Buffers acid from anaerobic metabolism
From cornea & lens
- **Mechanical function:** keep rigid eyes & maintain refractory power
- **Maintains intraocular pressure** (12-20 mmHg) cause steady formation & drainage. (if high it'll cause **glucoma**) which is a cause of blindness

*Glucoma may be open angle or close angle
Open angle -> more formation
Close angle -> less drainage*

Vitreous body

Vitreous body:

- Space behind lens
- In front of **retrolental space**
- Has hyaloid canal (lymph drainage)

Vitreous body functions:

Refractive eye media/ retina support/ lens support/ support spherical eye shape

Uveal tract

Uveal tract:

- Inner vascular layer give blood sup
- Contains three parts**
Iris, ciliary body, choroid (under retina)

Iris function:

- **absorb all light rays**
except ones entering pupil
- **Prevent light to pass**
peripheral parts of lens
(Prevent spherical chromatic aberrations)
- **Regulate light amount**
That enter eye
by pupil size regulation
(papillary light reflex)

Ciliary body function:

- **Accommodation**
- It's processes **secrete aqueous humor** in posterior chamber & give attachment to suspenders lens ligaments

Refractive media of eye

Crystalline lens

Causes of lens transparency:

- Uniform fibers arrangement
- No blood vessels
- Active process dehydration
- Constant chemical composition
- Nearly equal RIs of lens parts

Functions of lens:

- 30% Dioptric power (RI=1.4)
- Absorb UV rays (protect retina)
- accommodation to near vision enables the eye to see far or near by mechanism change its power from 20Ds to 32Ds

Abnormal lens conditions	Characters
Aphakia	No lens
Presbyopia	No accommodation to near objects Due to gradual decrease in lens' elasticity with age
Cataract	Loss of lens' transparency
Errors of refraction	<i>Myopia, hypermetropia, astigmatism</i>

Errors of refraction

i: a normal functioning eye lens is called **Emmetropic**
But if it's lens fail to converge light to on retina it's called **Ammetropic**
Like in **Myopia, Hypermetropia, & astigmatism**

Uveal tract

Choroid function:

- Blood supply to eye
- Vessel pressure maintain intraocular pressure
- Its melanin pigments absorb light & internal light reflection (**blur**)

Refraction errors	Cause	Correction
Myopia (Short sight) Rays converge <u>In front</u> of retina	- Abnormal long eyeball - Corneal or lens great curve	Objects brought nearer or use spherical concave lens
Hypermetropia (Long sight) Rays converge <u>Behind</u> the retina	- Abnormal short eyeball - Corneal or lens small curve	use spherical convex lens
Astigmatism Rays fall in more than one place on retina	- Corneal/lens Curves are irregular Thus falling rays are not on one focus	use cylindrical lens Which is longitudinal axis is perpendicular to the faulty eye plane