

# Eyeball

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## Introduction

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The eyeball is the **organ of sight**, structurally similar to a camera. It is **almost spherical**, measuring about **2.5 cm** in diameter. It has **three concentric coats**:

- **Outer (fibrous) coat:** Sclera + Cornea
- **Middle (vascular/uveal) coat:** Choroid, Ciliary body, Iris
- **Inner (nervous) coat:** Retina

Light enters through refracting media: **cornea ? aqueous humour ? lens ? vitreous.**

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## Outer Coat

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The **outer coat** includes **sclera** (posterior 5/6) and **cornea** (anterior 1/6).

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## Sclera

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- Opaque, tough, dense fibrous coat forming **posterior five-sixths** of eyeball.
- Thickest near optic nerve entry; thinnest **6 mm behind limbus** where recti insert; **weakest at optic nerve entrance.**
- Region at optic nerve perforations = **Lamina cribrosa.**

## Surfaces

- **Outer surface:** smooth, white, covered by **Tenon's capsule**; anterior part visible as "white of eye".
- **Inner surface:** brown, grooved for ciliary vessels/nerves; separated from choroid by **perichoroidal space** with **lamina fusca**.

### Continuity & Features

- Meets cornea at the **sclerocorneal junction/limbus**.
- Deep part contains **canal of Schlemm**, draining aqueous humour.

### Pierced by (important exam point)

- Optic nerve (slightly inferomedial).
- Ciliary nerves & arteries.
- Anterior ciliary arteries.
- **4 vortex veins (vorticosae veins)**.

### Vascularity

- Sclera is **almost avascular**.
- **Episclera** (loose connective tissue between conjunctiva and sclera) is **vascular**.

### Muscle attachment

- Recti ? anterior to equator
- Obliques ? posterior to equator

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## Dissection (Sclera)

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- Use a fresh **goat eyeball**.
- Remove fascial sheath, clean posterior ciliary nerves/vessels, identify vortex veins.
- Incise sclera at equator and strip it off from choroid.

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## Cornea

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### Features

- Transparent, forms **anterior one-sixth**.
- Junction with sclera = **limbus**.
- More **convex** than sclera.
- Separated from iris by **anterior chamber**.

### Nutrition

- **Avascular**.
- Nourished by:
  - Lymph in corneal spaces
  - Lacrimal fluid

### Nerve supply

- Branches of **ophthalmic nerve**
- **Short ciliary nerves** via ciliary ganglion
- **Pain is the only sensation** from cornea

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## Dissection (Cornea)

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- Incise around limbus to remove cornea.
- Expose iris, ciliary body, choroid.
- Strip iris, remove lens (floats in water).
- Vitreous escapes on removing lens.

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## Clinical Anatomy (Cornea)

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- Cornea can be **grafted** (avascular ? immune privilege).
- Injury causes **opacities ? visual disturbance**.
- Highly sensitive; even dust causes **pain**.
- Conjunctival inflammation ? **conjunctivitis**; palpebral conjunctiva used to assess **HB level**.
- Shape, curvature & AP diameter determine **refractive errors** (myopia, hypermetropia).

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## Middle Coat (Uveal Tract)

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The middle coat consists of:

- **Choroid**
- **Ciliary body**
- **Iris**

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## Choroid

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The choroid is a **thin, pigmented, vascular layer** lying between sclera and retina.

### Key Features

- Separates posterior sclera from retina.
- **Anterior end:** merges with ciliary body at **ora serrata**.
- **Posterior end:** pierced by optic nerve and attached firmly to it.
- **Outer surface:** separated from sclera by **suprachoroidal lamina**, containing ciliary nerves and vessels.
- **Attachments:** loose to sclera; firm to retina.

### Layers of Choroid

- Suprachoroid lamina
- Vascular lamina
- Choriocapillary lamina

- Bruch's membrane (basal lamina)

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## Ciliary Body

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The ciliary body is a **thickened part of the uveal tract** posterior to the corneal limbus.

### Key Features

- Continuous with **iris anteriorly** and **choroid posteriorly**.
- Suspends the lens and helps in **accommodation**.

### Structure

- **Triangular in cross section**.
- **Pars plana**: smooth posterior part.
- **Pars plicata**: anterior part with ~70 ciliary processes.

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## Iris

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The iris is the **coloured diaphragm** of the eye forming the pupil.

### Key Features

- Anteriorly covered by **mesothelium**, posteriorly by **deeply pigmented double-layered epithelium**.
- Iris stroma contains connective tissue, blood vessels, pigment cells.
- **Major arterial circle** at periphery; **minor arterial circle** near pupil.

- Eye colour depends on pigment density; fewer pigment cells ? blue iris.

## Muscles

- **Sphincter pupillae** – parasympathetic supply
- **Dilator pupillae** – sympathetic supply

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## Clinical Anatomy (Middle Coat)

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### Accommodation Reflex

- Looking far ? ciliary muscle relaxed, suspensory ligament tense, lens flat.
- Near vision ? ciliary muscle contracts, ligament relaxed, lens becomes round.

### Squint (Strabismus)

- Normal vision is binocular and 3D.
- Convergent squint: one eye turns inward.

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## Inner Coat / Retina

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### Basic Features

- Thin delicate inner layer, continuous with optic nerve.
- Outer retinal surface (pigment layer) attached to choroid.
- Inner surface contacts **hyaloid membrane** of vitreous.

- **Optic disc:** inferomedial to posterior pole, 1.5 mm diameter.

## Parts

- **Optic part:** light-sensitive; extends from optic disc to ora serrata.
- **Ciliary and iridial parts:** thin, non-nervous layers anterior to ora serrata.

## Specialized Areas

- **Physiological cup:** central depression of optic disc; no rods or cones ? blind spot.
- **Macula lutea:** lateral to optic disc, yellow, avascular.
- **Fovea centralis:** centre of macula; cones only; highest visual acuity; thinnest part of retina.

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## Clinical Anatomy (Retina)

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(Directly covered under Clinical Anatomy section of middle coat; retina-specific clinical notes appear later in chapter.)

### ? Key points from retrieved content

- Accommodation defects ? myopia, hypermetropia
- Squint arises due to misalignment of visual axes

## Aqueous Humour

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The aqueous humour is a **clear fluid** filling the space **between cornea (in front) and lens (behind)** in the **anterior segment** of the eye.



The iris divides this segment into **anterior** and **posterior chambers**, which communicate **freely via the pupil**.

### Formation & Drainage

- Secreted into the **posterior chamber** by **capillaries of ciliary processes**.
- Flows through pupil ? **anterior chamber**.
- Drains via:
  - **Iridocorneal angle** (spaces in ligamentum pectinatum)
  - **Canal of Schlemm**
  - ? Anterior ciliary veins

### Functions

- Maintains **intraocular pressure** and thereby the **optical dimensions** of the eyeball.
- Rich in **ascorbic acid, glucose, amino acids** ? nourishes **avascular cornea and lens**.

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### Clinical Anatomy – Aqueous Humour

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- Obstruction of outflow (or excess production) ? **raised intraocular pressure = glaucoma**.
- Glaucoma leads to:
  - **Cupping of optic disc**
  - **Pressure atrophy of retina**

- **Blindness**

- Glaucoma must be treated **urgently**.

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## Lens

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### Features

- Transparent, **biconvex** structure between anterior and posterior segments.
- Diameter ? **1 cm**.
- **Poles**: central points of anterior and posterior surfaces.
- **Axis**: line joining the poles.
- **Equator**: marginal circumference.
- Contributes **15 dioptres** to the total ~58 D of the eye.

### Curvature

- **Posterior surface** is more convex than anterior.
- Anterior surface kept **flattened** by tension of suspensory ligament.
- When ligament relaxes (ciliary muscle contracts), lens becomes **more convex**.

### Capsule & Epithelium

- Enclosed in thick elastic capsule (thickest anteriorly).

- Anterior surface has **cubical epithelium** centrally; at periphery, cells elongate ? **lens fibres**.

## Lens Substance

- **Nucleus**: central, oldest, firm fibres.
- **Cortex**: peripheral, softer, newer fibres.

## Suspensory Ligament (Zonule of Zinn)

- Attaches to:
  - Ciliary processes
  - Furrows between processes
  - Ora serrata
- Fibres attach to lens mostly **in front of equator**, some behind.

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## Dissection – Lens

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- Make an incision on **anterior surface**.
- Apply gentle pressure to **express the lens from its capsule**.

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## Clinical Anatomy – Lens

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- Lens becomes **opaque with age ? cataract**, requiring replacement.

- **Central retinal artery** is an end artery; blockage ? **sudden blindness**.
- **Third nerve paralysis** ? partial ptosis, dilated pupil, eye deviated down and out.
- **Horner's syndrome** ? partial ptosis + miosis.
- **Brainstem death** ? pupils fixed and dilated.
- Ophthalmoscopy allows observation of:
  - Diabetic/hypertensive retinal changes
  - Papilloedema (raised intracranial pressure)

## Vitreous Body

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The vitreous body is the **transparent, gel-like substance** that fills the posterior four-fifths of the eyeball.

It lies behind the lens and ciliary processes, which **indent the vitreous anteriorly**.

### Key Features (from the document's visible sections)

- Occupies the **vitreous chamber**.
- Maintains the **shape of the eyeball**.
- Supports the retina by pressing it against the choroid.
- Composed of:
  - Water
  - Hyaluronic acid

- Collagen fibrils
- Enclosed by a thin membrane called the **hyaloid membrane** (not directly in this snippet but referenced in adjacent retina content).

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## Development of Eye Structures

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The development information appears as a consolidated section under “DEVELOPMENT,” which applies to **lens, retina, vitreous region, sclera, choroid, cornea**, and related structures.

### Development Summary

- **Optic vesicle** ? forms **optic cup**, an outpouching from forebrain.
- **Lens** ? develops from the **lens placode (ectodermal)**.
- **Retina:**
  - Pigmented layer ? from **outer layer** of optic cup
  - Nervous layers ? from **inner layer** of optic cup
- **Choroid & sclera** ? from **mesoderm**
- **Cornea:**
  - Epithelium ? **surface ectoderm**
  - Remaining layers ? **mesoderm**

*(The vitreous body itself forms largely from secondary mesenchyme surrounding the optic cup; although this specific line is not fully visible in the retrieved page, the adjoining description confirms the region.)*

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## Molecular Regulation

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The molecular signals controlling eye development are clearly described:

### Key Molecular Regulators

- **WNT, BMP, TGF- $\beta$ , FGF** ? regulate **optic vesicle** formation
- **PAX6** ? essential for **lens vesicle differentiation**
- **Sonic hedgehog (SHH)** has two critical roles:
  - **Inhibition of SHH** + expansion of **PAX2** ? **failure of eye separation** ? **cyclopia**
  - **Overexpression of SHH** ? **loss of eye structures**
- **Vitamin A deficiency** in pregnancy ? **anterior segment defects** (cornea, eyelids)

## Clinical Problems — Solutions & Reasoning (Full Eyeball Chapter)

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### 1. Retinal Detachment

#### Clinical Problem

A patient reports sudden flashes of light, floaters, and a curtain-like shadow descending over the visual field.

#### Reasoning

- The retina has **two layers** with different embryological origins.

- The **outer pigmented layer** adheres firmly to the choroid.
- The **inner nine nervous layers** are loosely attached and can separate.
- When the inner layers pull away, photoreceptors lose blood supply from choroid and central retinal artery branches.
- This produces visual field defects.

### Solution

Immediate ophthalmologic evaluation with **urgent retinal reattachment**, such as pneumatic retinopexy, scleral buckle, or vitrectomy, to prevent permanent loss of photoreceptor function.

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## 2. Cataract (Lens Opacity)

### Clinical Problem

An elderly patient has painless progressive blurring of vision and difficulty seeing at night.

### Reasoning

- The lens grows throughout life.
- Aging causes **lens fibres to lose transparency**, especially in the nucleus.
- The lens becomes denser and scatters light, producing glare and blurred vision.

### Solution

Surgical removal of the opaque lens and implantation of an **intraocular lens**, restoring transparency and focusing capacity.

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### 3. Acute Angle-Closure Glaucoma

#### Clinical Problem

A patient presents with severe eye pain, headache, halos around lights, red eye, and a mid-dilated pupil.

#### Reasoning

- Aqueous humour is produced in the posterior chamber and drains through the **iridocorneal angle** into the canal of Schlemm.
- Blockage at this angle rapidly increases intraocular pressure.
- Rising pressure compresses the optic nerve and retinal blood flow.

#### Solution

Immediate reduction of intraocular pressure using medications (acetazolamide,  $\beta$ -blockers) followed by definitive procedures like **laser peripheral iridotomy**.

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### 4. Central Retinal Artery Occlusion

#### Clinical Problem

A patient develops sudden, painless, complete vision loss in one eye.

#### Reasoning

- The **central retinal artery** is an **end artery** supplying the inner retinal layers.
- Occlusion stops blood flow  $\rightarrow$  ischemia  $\rightarrow$  sudden blindness.



- The outer retina may still receive minimal diffusion from choroidal vessels, but this is insufficient.

## Solution

Urgent ocular massage, lowering intraocular pressure, and rapid management of embolic risk—but prognosis is usually poor due to irreversible ischemia within minutes.

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## 5. Third Nerve Palsy

### Clinical Problem

A patient has ptosis, a dilated pupil, and an eye deviated “down and out.”

### Reasoning

- Third nerve supplies:
  - **Levator palpebrae (ptosis)**
  - **Sphincter pupillae (pupil dilatation)**
  - **Most extraocular muscles** except lateral rectus and superior oblique.
- Paralysis leaves the unopposed lateral rectus and superior oblique, pulling the eye downwards and laterally.

## Solution

Identify the cause—aneurysm, diabetes, trauma—and provide targeted treatment; pupil involvement suggests compression (often life-threatening).

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## 6. Horner Syndrome

### Clinical Problem

A patient has ptosis, miosis, and facial anhidrosis.

### Reasoning

- Caused by interruption of sympathetic fibres.
- The **dilator pupillae** loses input ? constricted pupil.
- **Superior tarsal muscle** loses tone ? mild ptosis.
- Sweat glands lose sympathetic supply ? anhidrosis.

### Solution

Treat underlying cause such as tumour, carotid dissection, or spinal lesion.

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## 7. Myopia and Hypermetropia

### Clinical Problem

A young adult has difficulty seeing distant objects (or near objects).

### Reasoning

- **Myopia:** Eyeball too long / lens too strong ? image focuses **in front of retina**.
- **Hypermetropia:** Eyeball too short / lens too weak ? image focuses **behind retina**.

### Solution

- Myopia: **Concave lenses**
  - Hypermetropia: **Convex lenses**
  - Refractive surgery when indicated.
- 

## 8. Loss of Accommodation (Presbyopia)

### Clinical Problem

A middle-aged patient cannot focus on near objects.

### Reasoning

- Ciliary muscle contraction normally relaxes zonular fibres ? lens becomes convex.
- With age, lens loses elasticity ? cannot increase curvature.

### Solution

Reading glasses with **convex lenses** to augment near focus.

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## 9. Corneal Ulcer Causing Severe Photophobia

### Clinical Problem

A patient with a corneal ulcer experiences intense photophobia and reflex tearing.

### Reasoning

- Cornea is **highly innervated** (ophthalmic division of trigeminal nerve).

- Damage ? severe pain + reflex blepharospasm.
- Iris shares common pathways and becomes inflamed, adding photophobia.

## **Solution**

Topical antimicrobials, cycloplegics, and urgent ophthalmology follow-up.

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## **10. Optic Disc Swelling (Papilledema)**

### **Clinical Problem**

A patient with chronic headache shows bilateral swollen optic discs on fundus exam.

### **Reasoning**

- Raised intracranial pressure is transmitted along the optic nerve sheath.
- This compresses the optic nerve head and retinal venous return ? disc edema.
- Vision may initially remain normal before late deterioration.

## **Solution**

Treat underlying raised intracranial pressure (tumour, hydrocephalus, infection).

## **? Frequently Asked Questions (FAQs) — Eyeball**

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### **1. What are the three coats of the eyeball?**

- **Outer coat:** Sclera + Cornea

- **Middle coat (Uveal tract):** Choroid + Ciliary body + Iris
  - **Inner coat:** Retina
- 

## 2. Why is the cornea transparent?

Because it is **avascular**, has **regularly arranged collagen fibres**, and maintains **constant hydration**.

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## 3. Why can the cornea be transplanted easily?

It is **avascular**, so the risk of immune rejection is extremely low.

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## 4. What is the sclera made of and why does it appear white?

Dense, irregular collagen fibres that scatter light ? **white opacity**.

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## 5. What is the lamina cribrosa?

The perforated region of sclera through which the **optic nerve fibres** exit.

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## 6. What is the function of the choroid?

Provides **nutrients** to the outer retina, especially rods and cones via choriocapillaris.

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## 7. What are the parts of the ciliary body?

- **Pars plana** (smooth)
  - **Pars plicata** with ciliary processes
- 

## 8. What is the role of the ciliary muscle?

Controls accommodation by changing **lens curvature**.

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**9. Which muscle constricts the pupil?**

**Sphincter pupillae** (parasympathetic supply).

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**10. Which muscle dilates the pupil?**

**Dilator pupillae** (sympathetic supply).

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**11. What determines eye colour?**

The **amount of pigment** in iris stroma.

Less pigment ? blue; more ? brown/black.

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**12. What is the optic disc?**

The area where optic nerve fibres exit; contains **no photoreceptors** ? called the **blind spot**.

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**13. What is the macula lutea?**

A yellow, cone-rich region responsible for **sharp vision**.

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**14. What is the fovea centralis?**

Center of macula; **only cones**, thinnest retina, highest visual acuity.

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**15. What fluid fills the anterior chamber?**

**Aqueous humour**.

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**16. Where is aqueous humour produced?**

Capillaries of **ciliary processes**.

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**17. How does aqueous humour drain?**

Iridocorneal angle ? **canal of Schlemm** ? anterior ciliary veins.

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### 18. What causes glaucoma?

Blocked outflow of aqueous humour ? **raised intraocular pressure** ? optic nerve damage.

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### 19. What are the functions of aqueous humour?

- Maintains intraocular pressure
  - Nourishes cornea and lens
  - Removes metabolites
- 

### 20. What is the structure of the lens?

- Biconvex
  - Surrounded by capsule
  - Has nucleus and cortex
  - Suspended by **zonular fibres**
- 

### 21. Why does the lens become more convex during near vision?

Ciliary muscle **contracts** ? zonular fibres **relax** ? lens bulges.

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### 22. What is cataract?

Opacity of the lens, commonly due to aging.

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### 23. What fills the vitreous chamber?

**Vitreous body**, a gel containing water, collagen and hyaluronic acid.

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#### 24. What is the role of the vitreous body?

Maintains eyeball shape and presses retina against choroid.

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#### 25. Why does retinal detachment occur?

The inner neural retina separates from the outer pigmented layer due to traction, fluid accumulation, or trauma.

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#### 26. What is the blood supply of the retina?

- **Outer layers:** Choroidal vessels
  - **Inner layers:** Central retinal artery
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#### 27. Why is central retinal artery occlusion an emergency?

It is an **end artery** ? occlusion leads to sudden, irreversible blindness.

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#### 28. What is papilloedema?

Swelling of optic disc due to **raised intracranial pressure**.

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#### 29. Why is the fovea the point of highest visual acuity?

- Only cones
  - No blood vessels (avascular zone)
  - Thinnest retina
  - Direct entry of light
- 

#### 30. What embryological structure gives rise to the retina?



The **optic cup**.

## ? Frequently Asked Questions (FAQs) — Eyeball

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- 

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The **optic cup**.

### More MCQs — Eyeball (Advanced Set)

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#### 1. The sclera is thinnest at:

- a. Limbus
- b. Equator
- c. Region of muscle insertion
- d. Optic nerve entrance

**Answer: d. Optic nerve entrance**

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#### 2. The space between the sclera and choroid is called:

- a. Subretinal space
- b. Perichoroidal space
- c. Tenon's space
- d. Aqueous sinus

**Answer: b. Perichoroidal space**

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**3. Vorticose veins drain the:**

- a. Retina
- b. Sclera
- c. Choroid
- d. Optic nerve

**Answer: c. Choroid**

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**4. The iris epithelium is derived from:**

- a. Surface ectoderm
- b. Neural crest
- c. Mesoderm
- d. Neuroectoderm

**Answer: d. Neuroectoderm**

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**5. The major arterial circle of iris lies in the:**

- a. Pupillary margin
- b. Iris root
- c. Ciliary body
- d. Choroid

**Answer: b. Iris root**

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**6. Which structure forms the anterior boundary of the posterior chamber?**

- a. Lens
- b. Cornea
- c. Iris
- d. Vitreous

**Answer: c. Iris**

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**7. The anterior surface of the lens is kept flattened by:**

- a. Zonular fibre relaxation
- b. Zonular fibre tension
- c. Contraction of sphincter pupillae
- d. Vitreous pressure

**Answer: b. Zonular fibre tension**

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**8. The central depression on the optic disc is called:**

- a. Macula
- b. Cup
- c. Ora serrata
- d. Foveola

**Answer: b. Cup**

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**9. The corneal reflex is mediated by:**

- a. V1 and VII
- b. V2 and VII
- c. V3 and VII
- d. V1 and VI

**Answer: a. V1 and VII**

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**10. The nerve supply of the dilator pupillae is:**

- a. Parasympathetic
- b. Somatic motor
- c. Sympathetic
- d. Sensory

**Answer: c. Sympathetic**

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**11. The retinal area with no blood vessels is:**

- a. Optic disc
- b. Macula
- c. Fovea centralis
- d. Ora serrata

**Answer: c. Fovea centralis**

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**12. Which retinal layer contains photoreceptors?**

- a. Ganglion cell layer
- b. Nuclear fibre layer
- c. Rod and cone layer
- d. Bipolar cell layer

**Answer: c. Rod and cone layer**

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**13. Light entering the eye first affects which retinal layer?**

- a. Photoreceptors
- b. Ganglion cells
- c. Bipolar cells
- d. Pigmented layer

**Answer: b. Ganglion cells**

*(Because light travels from inner surface ? outward.)*

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**14. The ora serrata marks the junction of:**

- a. Retina and optic nerve
- b. Cornea and sclera
- c. Neural and non-neural retina
- d. Iris and ciliary body

**Answer: c. Neural and non-neural retina**

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**15. The hyaloid artery in fetal life supplies the:**



- a. Retina
- b. Optic cup
- c. Lens
- d. Cornea

**Answer: c. Lens**

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**16. The vitreous body is mainly composed of:**

- a. Albumin
- b. Hyaluronic acid
- c. Keratin
- d. Elastic fibres

**Answer: b. Hyaluronic acid**

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**17. Eye colour is determined by pigment in the:**

- a. Pigmented epithelium of iris
- b. Stroma of iris
- c. Ciliary processes
- d. Retina

**Answer: b. Stroma of iris**

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**18. The fovea appears yellow due to:**

- a. High melanin
- b. Xanthophyll pigment
- c. Dense rods
- d. Retinal blood vessels

**Answer: b. Xanthophyll pigment**

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**19. Accommodation for near vision requires all EXCEPT:**

- a. Ciliary muscle contraction
- b. Relaxation of zonular fibres
- c. Lens becoming more convex
- d. Pupillary dilatation

**Answer: d. Pupillary dilatation**

(Pupil **constricts** for near vision.)

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**20. The most common cause of sudden painless loss of vision is:**

- a. Cataract
- b. Optic neuritis
- c. Central retinal artery occlusion
- d. Glaucoma

**Answer: c. Central retinal artery occlusion**

### ? MCQs — Eyeball (Set 3: Advanced/Challenging)

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**1. The “dangerous area” for retinal detachment is commonly associated with:**

- a. Optic disc
- b. Ora serrata
- c. Macula
- d. Choroid

**Answer: b. Ora serrata**

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**2. Which structure helps maintain the depth of the anterior chamber?**

- a. Lens capsule
- b. Aqueous humour
- c. Ciliary muscle
- d. Hyaloid canal

**Answer: b. Aqueous humour**

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**3. The canal of Schlemm communicates directly with:**

- a. Posterior chamber
- b. Vorticosse veins
- c. Anterior ciliary veins
- d. Vitreous body

**Answer: c. Anterior ciliary veins**

---

**4. Greatest refractive index in the eye is found in:**

- a. Cornea
- b. Vitreous
- c. Aqueous humour
- d. Lens nucleus

**Answer: d. Lens nucleus**

---

**5. The uveal tract does NOT include:**

- a. Iris
- b. Choroid
- c. Ciliary body
- d. Retina

**Answer: d. Retina**

---

**6. The hyaloid canal (Cloquet's canal) is a remnant of:**

- a. Neural crest
- b. Hyaloid artery
- c. Vitreous vein
- d. Surface ectoderm

**Answer: b. Hyaloid artery**

---

**7. The “red reflex” seen on ophthalmoscopy disappears in:**

- a. Myopia
- b. Papilloedema
- c. Cataract
- d. Hypermetropia

**Answer: c. Cataract**

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**8. The anterior border of the vitreous chamber is formed by:**

- a. Retina
- b. Lens and ciliary body
- c. Iris
- d. Choroid

**Answer: b. Lens and ciliary body**

---

**9. Which retinal layer contains the axons forming the optic nerve?**

- a. Inner nuclear layer
- b. Outer plexiform layer
- c. Nerve fibre layer
- d. Photoreceptor layer

**Answer: c. Nerve fibre layer**

---

**10. The pigment epithelium of retina is essential for:**

- a. Colour vision
- b. Regeneration of photopigments
- c. Transmission of impulses
- d. Aqueous humour production

**Answer: b. Regeneration of photopigments**

---

**11. The space of Fontana is related to:**

- a. Aqueous outflow
- b. Lens accommodation
- c. Extraocular muscle insertion
- d. Macular reflex

**Answer: a. Aqueous outflow**

---

**12. The lens receives nutrition primarily from:**

- a. Retinal vessels
- b. Vitreous humour
- c. Aqueous humour
- d. Choroid

**Answer: c. Aqueous humour**

---

**13. The fovea centralis is avascular to reduce:**

- a. Colour distortion
- b. Chromatic aberration
- c. Light scattering
- d. Accommodation effort

**Answer: c. Light scattering**

---

**14. The main function of the Bruch's membrane is to:**

- a. Anchor rods and cones
- b. Act as a diffusion barrier between retina and choroid
- c. Maintain vitreous pressure
- d. Nourish optic nerve

**Answer: b. Act as a diffusion barrier between retina and choroid**

---

**15. Which extraocular muscle tendon passes through the trochlea?**

- a. Superior oblique
- b. Inferior oblique
- c. Superior rectus
- d. Lateral rectus

**Answer: a. Superior oblique**

---

**16. The anterior chamber angle is formed between:**

- a. Iris and cornea
- b. Lens and cornea
- c. Iris and ciliary body
- d. Lens and iris

**Answer: a. Iris and cornea**

---

**17. What determines the near point of accommodation?**

- a. Corneal curvature
- b. Lens elasticity
- c. Vitreous tension
- d. Extraocular muscles

**Answer: b. Lens elasticity**

---

**18. The ora serrata corresponds to the termination of:**

- a. Rods and cones
- b. Retinal vessels
- c. Optic disc fibres
- d. Scleral spur

**Answer: a. Rods and cones**

---

**19. Which part of the optic nerve is most susceptible to raised intracranial pressure?**

- a. Intraocular
- b. Intraorbital
- c. Intracanalicular
- d. Intracranial

**Answer: a. Intraocular**

*(Papilloedema occurs here.)*

---

**20. A cherry-red spot is seen in:**

- a. Central retinal artery occlusion
- b. Central retinal vein occlusion
- c. Cataract
- d. Glaucoma

**Answer: a. Central retinal artery occlusion**

**? Viva Voce — Eyeball (Full Chapter)**

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**1. What are the three coats of the eyeball?**

Outer fibrous coat, middle vascular coat, and inner nervous coat.

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**2. Which part of the eyeball is responsible for most of its refractive power?**

The **cornea**.

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**3. Why is the cornea transparent?**

Regular collagen arrangement, avascularity, and controlled hydration.

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**4. What is the limbus?**

The junction between the **cornea and sclera**.

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**5. What is the weakest part of the sclera?**

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The **area where the optic nerve exits** (lamina cribrosa).

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**6. What is Tenon's capsule?**

A fascial sheath around the eyeball, allowing smooth movements.

---

**7. Name the layers of the cornea.**

Epithelium, Bowman's layer, stroma, Descemet's membrane, endothelium.

---

**8. Why is the cornea very sensitive to pain?**

It is supplied richly by the **ophthalmic division of trigeminal nerve**.

---

**9. What structure nourishes the cornea?**

Aqueous humour and lacrimal fluid.

---

**10. What is the function of the choroid?**

Nourishes the **outer retina**, especially rods and cones.

---

**11. What are the parts of the ciliary body?**

Pars plana and pars plicata (with ciliary processes).

---

**12. What is the function of the ciliary muscle?**

Accommodation — changes the shape of the lens for near vision.

---

**13. Which nerve controls accommodation?**

Parasympathetic fibres through the **oculomotor nerve**.

---

**14. What are the muscles of the iris?**



Sphincter pupillae (parasympathetic) and dilator pupillae (sympathetic).

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**15. Why is the iris colored?**

Due to the **amount of pigment** in its stroma.

---

**16. What is the optic disc?**

Point where optic nerve exits; no photoreceptors ? **blind spot**.

---

**17. What is the macula lutea?**

A yellow region responsible for **detailed central vision**.

---

**18. Why is the fovea the point of highest visual acuity?**

Only cones, no blood vessels, and thinnest retinal layers.

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**19. Which artery supplies the inner layers of retina?**

Central retinal artery.

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**20. Which artery supplies the outer layers?**

Choroidal vessels.

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**21. What is the aqueous humour?**

Clear fluid in anterior and posterior chambers maintaining IOP.

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**22. Where is aqueous humour formed?**

By ciliary processes.

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**23. How does it drain?**

Iridocorneal angle ? canal of Schlemm ? ciliary veins.

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**24. What happens when its outflow is blocked?**

Intraocular pressure rises ? **glaucoma**.

---

**25. What is the function of the lens?**

To fine-tune focus during accommodation.

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**26. Why does the lens become opaque with age?**

Gradual degeneration of lens fibres ? **cataract**.

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**27. What is the vitreous body?**

A transparent gel filling the posterior segment, supporting retina.

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**28. Why does vitreous degeneration cause floaters?**

Liquefaction causes tiny collagen strands to cast shadows on retina.

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**29. What is the developmental origin of the retina?**

Optic cup (neuroectoderm).

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**30. What is the developmental origin of lens?**

Surface ectoderm (lens placode).

---

**31. What is papilledema?**

Optic disc swelling due to **raised intracranial pressure**.

---

**32. What is the first sign of central retinal artery occlusion?**

Sudden painless blindness with a **cherry-red spot**.

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**33. What is retinitis pigmentosa?**

Progressive degeneration of photoreceptors with night blindness.

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**34. What is the ora serrata?**

The anterior limit of the **light-sensitive retina**.

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**35. Why do diabetics require regular fundus exam?**

To detect **diabetic retinopathy**, which can cause blindness.

---

**36. What is meant by accommodation reflex?**

Pupil constriction + lens thickening + convergence for near vision.

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**37. What is the hyaloid canal?**

A remnant of the foetal hyaloid artery within vitreous.

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**38. Why does a blow to the eye sometimes cause hyphema?**

Tearing of iris vessels ? blood in anterior chamber.

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**39. Which structure produces the “red reflex”?**

Reflection of light from **vascular retina**.

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**40. What causes “night blindness”?**

Vitamin A deficiency affecting **rods**.