RETINA 👁️

Definition

The retina is a thin, transparent nervous layer that forms the innermost layer of the eyeball.
It is the sensory part of the eye responsible for converting light into nerve impulses, which are then transmitted to the brain through the optic nerve.

Flowchart:

Light entering eye → Retina photoreceptors stimulated → Electrical signals generated → Signals transmitted via optic nerve → Visual cortex interprets image

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Development of Retina 🧬

The retina is neuroectodermal in origin and develops from the invagination of the primary optic vesicle, forming the optic cup.

Flowchart:

Primary optic vesicle → Invagination → Formation of optic cup
- Outer layer → Retinal Pigment Epithelium (RPE)
- Inner layer → Sensory Retina

Important exam point:

- The two layers of the optic cup give rise to the two main retinal components.

Gross Anatomy of Retina 🔍

The retina extends from the optic disc to the ora serrata.

Key anatomical landmarks

Structure	Description
Optic disc	Circular pink area (≈1.5 mm diameter) where retinal nerve fibers converge to form the optic nerve
Ora serrata	Serrated anterior limit of retina
Retinal equator	Imaginary line passing through the exit of four vortex veins
Posterior pole	Retina posterior to the equator
Peripheral retina	Retina between equator and ora serrata

Flowchart:

Optic disc → Posterior pole → Retinal equator → Peripheral retina → Ora serrata

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Thickness of Retina 📏

Retinal thickness varies in different areas.

Location	Thickness
Near optic disc	0.56 mm
Fovea	Thinnest part
Ora serrata	0.1 mm

Important concept:

- The fovea is the thinnest and most specialized region of the retina.

Components of Retina 🔬

The retina consists of two main parts.

1. Retinal Pigment Epithelium (RPE) 🎨

- Single layer of pigmented cells
- Extends from optic disc to ora serrata

Functions of RPE

- Absorbs excess light (reduces reflection)
- Supports photoreceptors
- Participates in visual cycle of vitamin A

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2. Sensory Retina ⚡

The sensory retina is responsible for light perception and signal transmission.

It consists of three main components:

(A) Neural Cells

Cell Type	Function
Rods	Night vision and peripheral vision
Cones	Color vision and visual acuity
Bipolar cells	Transmit signals from photoreceptors

Ganglion cells	Axons form the optic nerve

Numbers (important exam fact):

- Rods: ~120 million
- Cones: ~6.5 million

(B) Interneurons

Cell	Function
Horizontal cells	Integrate signals between photoreceptors
Amacrine cells	Modulate signal transmission in inner retina

(C) Supporting Cells

Müller cells (glial cells)

Functions:

- Structural support
- Maintain retinal metabolism
- Maintain ionic balance

Microscopic Structure of Retina 🔬

The retina contains 10 histological layers, arranged from outer → inner.

Layer	Description
1	Retinal pigment epithelium
2	Rods and cones
3	External limiting membrane
4	Outer nuclear layer
5	Outer plexiform layer

6	Inner nuclear layer
7	Inner plexiform layer
8	Ganglion cell layer
9	Nerve fiber layer
10	Internal limiting membrane

Flowchart:

Photoreceptors (rods/cones) → Bipolar cells → Ganglion cells → Nerve fiber layer → Optic nerve

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Specialized Areas of Retina 📍

Macula Lutea 🔍

The macula lutea is the specialized central area of the retina responsible for detailed vision.

Characteristics:

- Located at posterior pole
- Diameter 5-6 mm
- Responsible for central vision

Fovea Centralis 🎯

The fovea is the most sensitive region of the retina.

Characteristics:

Feature	Description
Diameter	1.5 mm
Shape	Depression in retina

Function	Maximum visual acuity

Key features:

- Highest cone density
- No rods
- Specialized for fine vision

Foveola 🌟

The foveola is the central pit of the fovea.

Characteristics:

Feature	Description
Diameter	0.35 mm (350 μm)
Cells	Only cones present

Layers	Thinnest retina

Important features:

- No rods
- No ganglion cells
- Highest visual resolution

Foveal Avascular Zone (FAZ) 🚫🩸

The FAZ is the central region of the retina without blood vessels.

Characteristics:

- Diameter ≈ 0.5 mm
- Surrounded by capillaries

Importance:

- Prevents vascular obstruction of light
- Maintains high visual acuity

Blood Supply of Retina 🩸

The retina receives blood from three main arterial sources.

1. Central Retinal Artery 🚑

- Supplies inner retinal layers
- Extends up to outer plexiform layer
- Forms end-arterial system (no anastomosis)

Clinical importance:

- Occlusion leads to central retinal artery occlusion (CRAO).

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2. Short Posterior Ciliary Arteries 🌐

Supply:

- Choriocapillaries

- Retinal pigment epithelium
- Photoreceptors

These arteries nourish the outer retina.

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3. Cilio-Retinal Artery 📍

- Present in ~30% of individuals
- Supplies macular region

Clinical significance:

- Can preserve macular vision in CRAO.

Venous Drainage 🔄

The retinal veins follow the same pattern as retinal arteries.

Drainage pathway:

Retinal veins → Central retinal vein →

- Directly into cavernous sinus

OR

- Via superior ophthalmic vein → cavernous sinus

Blood-Retinal Barrier 🛡️

This barrier maintains retinal transparency and regulates nutrient exchange.

Types of Blood-Retinal Barrier

Type	Formed By	Function
Internal barrier	Tight junctions of retinal capillary endothelium	Controls substances entering sensory retina
External barrier	Tight junctions of RPE cells	Regulates nutrients from choriocapillaries

Flowchart:

Blood → Capillary endothelium (internal barrier) → Retina

Blood → Choriocapillaries → RPE junctions (external barrier) → Photoreceptors

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Functions of Retina ⚡

The retina performs multiple visual functions:

Function	Description
Visual acuity	Sharp central vision
Colour vision	Cones detect different wavelengths
Dark adaptation	Rods function in dim light
Contrast sensitivity	Detect differences between light intensities

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Functional Division of Retina 🔀

The retina is functionally divided into:

- Temporal retina
- Nasal retina

Flowchart:

Retinal fibers originate → Optic nerve → Optic chiasma

Pathways:

Temporal retinal fibers → Remain on same side →
Ipsilateral optic tract → Lateral geniculate body

Nasal retinal fibers → Cross at optic chiasma →
Contralateral optic tract → Lateral geniculate body

🩺 Retinal Imaging Techniques

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1. FFA (Fundus Fluorescein Angiography)

Definition:

FFA is an imaging test used to visualize the blood circulation of the retina and choroid.

Procedure:

1. Fluorescein dye is injected into a vein (usually in the arm).
2. The dye travels through the bloodstream to the retinal vessels.
3. A special camera takes rapid photographs of the retina as the dye passes through the vessels.

What it shows:

- Retinal blood vessel circulation
- Leakage of vessels
- Blocked vessels
- Areas of ischemia
- Neovascularization

Uses:

- Diabetic retinopathy
- Age-related macular degeneration
- Retinal vein occlusion
- Retinal artery occlusion
- Macular edema

Key point: FFA studies retinal blood vessels and vascular leakage.

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2. OCT (Optical Coherence Tomography)

Definition:

OCT is a non-invasive imaging technique that gives cross-sectional images of the retina, similar to an optical biopsy.

Principle:

- Uses low-coherence infrared light.
- Works similar to ultrasound but with light instead of sound.

What it shows:

- Layers of the retina
- Macular thickness
- Fluid accumulation
- Structural damage

Uses:

- Macular edema
- Macular hole
- Epiretinal membrane
- Age-related macular degeneration
- Glaucoma (RNFL thickness)

Key point: OCT studies retinal structure and thickness.

✅ Exam Difference

Feature	FFA	OCT

Type	Invasive (dye injection)	Non-invasive
Shows	Blood vessels & leakage	Retinal layers
Best for	Vascular diseases	Structural retinal disease

💡 One-liner:

- FFA: Imaging of retinal circulation using fluorescein dye.
- OCT: Non-invasive cross-sectional imaging of retinal layers using light.

-> The End <-