Anatomy of Retina and vitreous

- The retina is a thin, semitransparent, multilayered sheet of neural tissue that lines the inner aspect of the posterior two-thirds of the wall of the globe.
- Thin delicate layer of nervous tissue
- Surface area of 266 mm^2
- Extends from optic disc to ora serrata

Visible LAND MARKS of Human Retina

Optic Disc

Retinal Blood Vessels

Area centralis with fovea and foveola

Peripheral retina and ora serrata

Thickest near the optic disc

Thin towards the peripheral

OPTIC DISC:

Circular or slightly oval app. 1.5mn

In the central contains a depression known as Physiological Cup

AREA CENTRALIS:

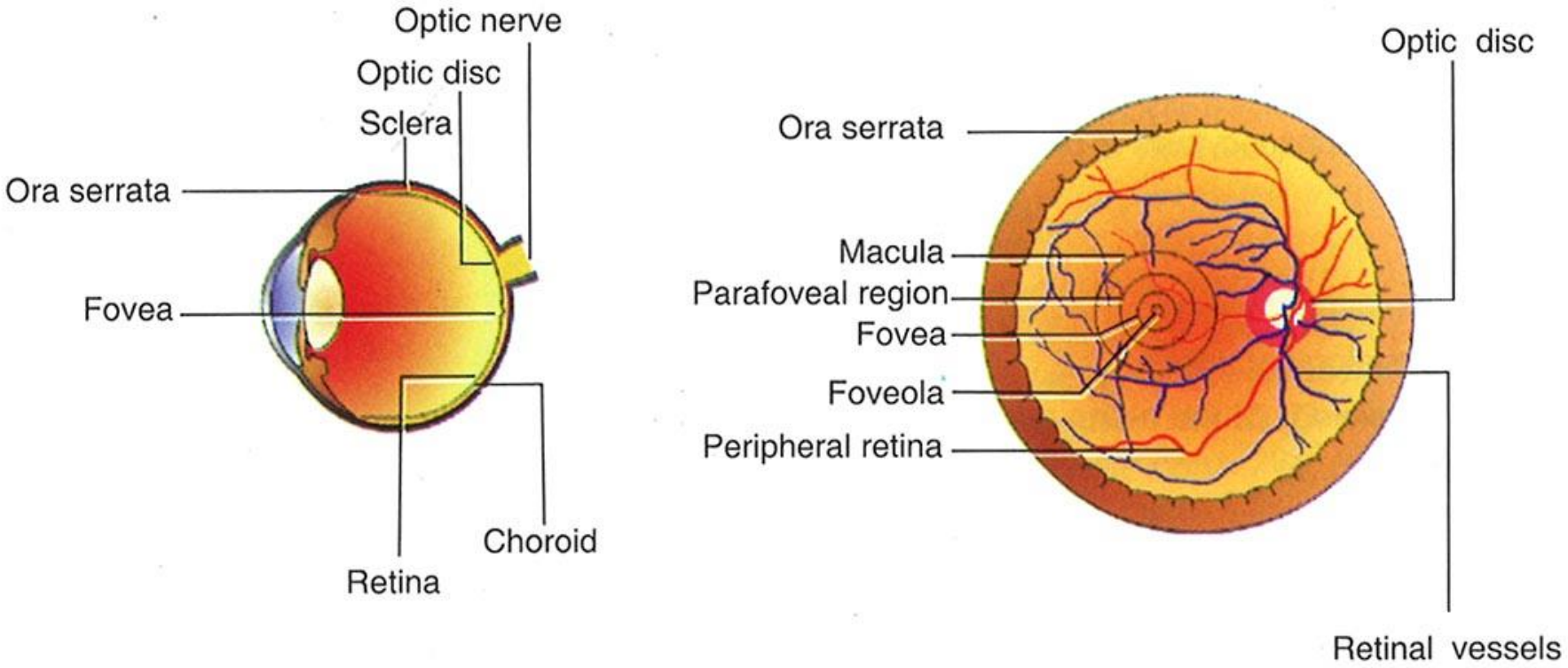
It is demarcated app. by upper and lower arcuate and temporal retinal vessels.

Corresponds to app. 15^0 of the visual field and adopted for accurate diurnal vision and colour discrimination.

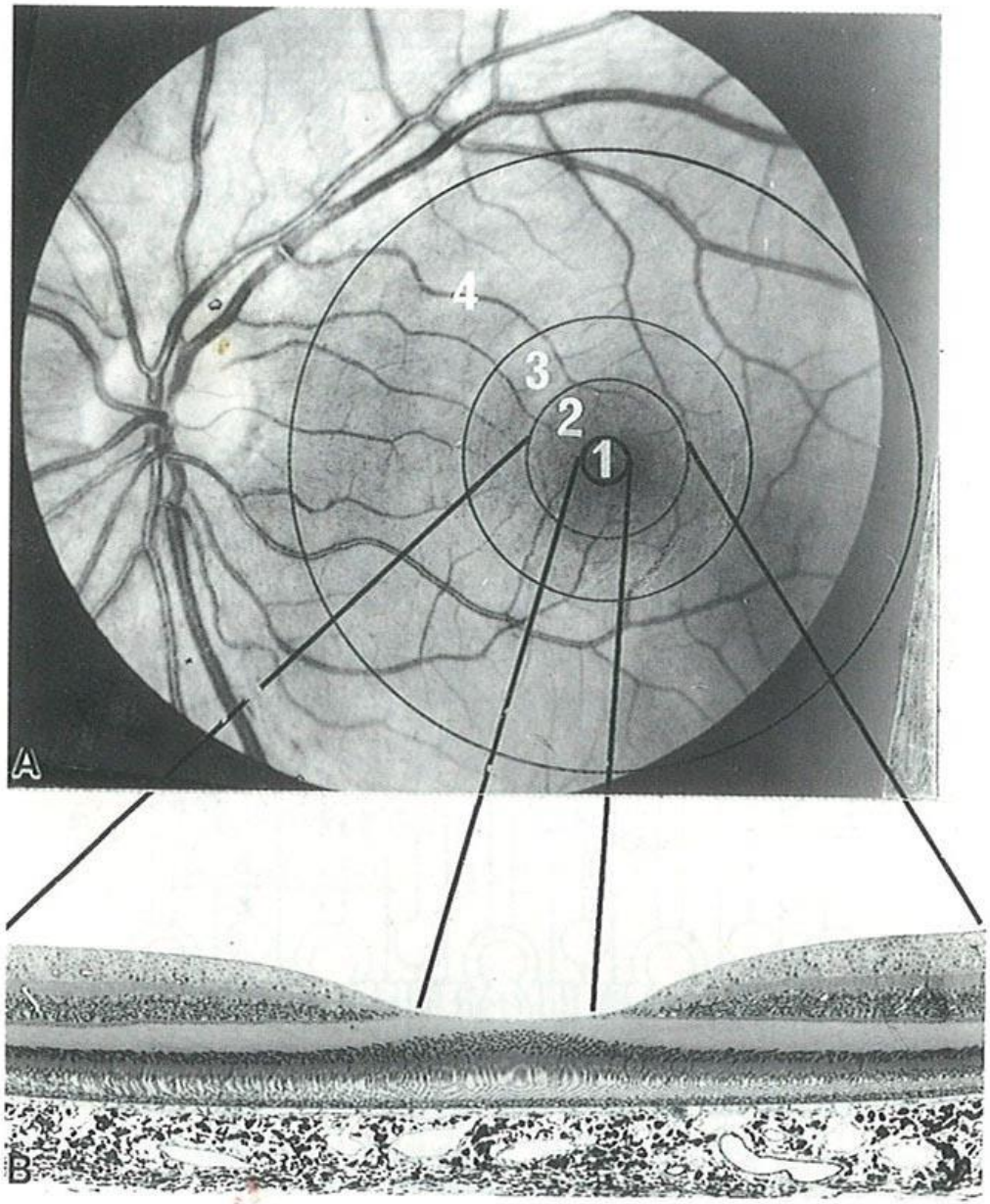
It is divisible into fovea and foveola

FOVEA:

Center of area centralis 4mm temporal to the center of the optic disc.



Gross anatomy of the retina.


4
3
2
1
A
B

In this layer has there are no rods.

Cones are larger and abundant its central part consist of cones and there nuclei covered by a thin internal limiting membrane. All other layers are absent in this region.

In the center of the foveola there is tiny depression known as umbo. It corresponds to foveolar reflex.

PERIPHERAL RETINA:

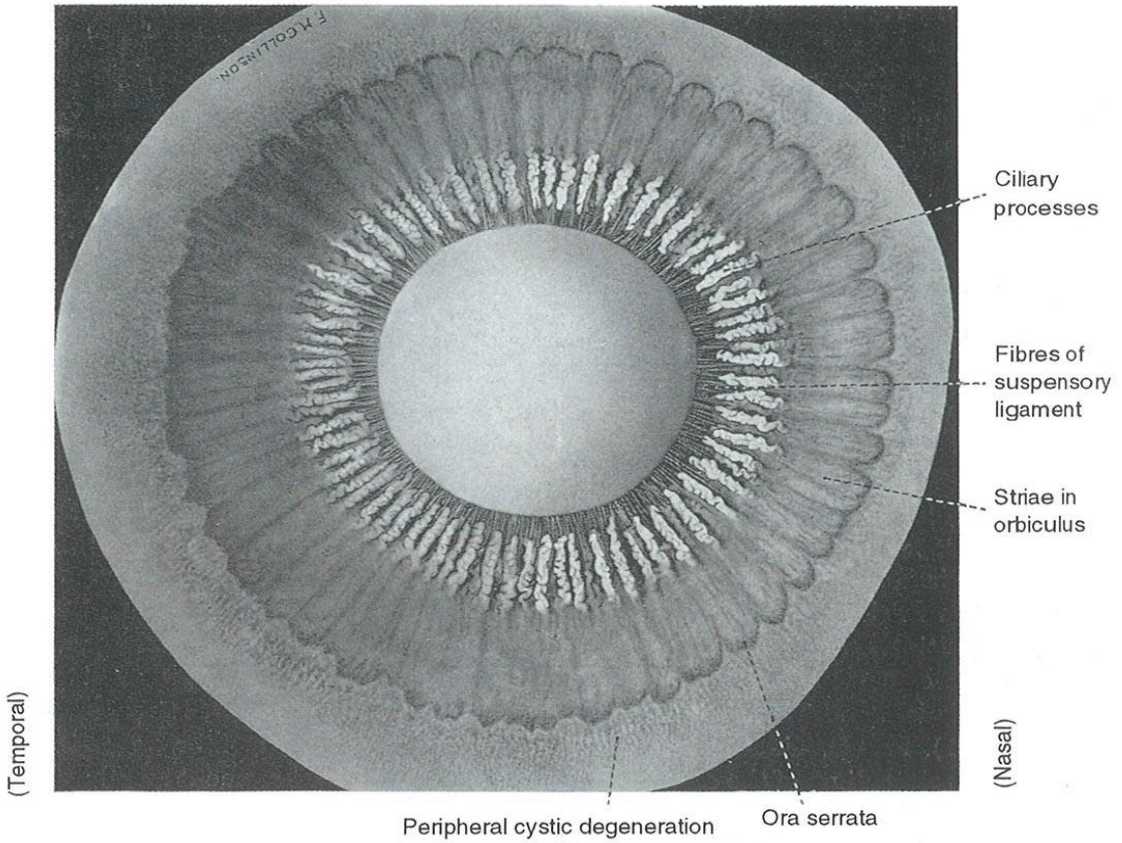
4 Regions

1. **Near periphery:** Circumscribed region of about 1.5mm around the area centralis.
2. **Mid periphery:** Occupies 3mm wide zone around the near periphery.
3. **Far periphery:** Extends from the optic disc 9-10mm on the temporal side and 16mm on the nasal side in the horizontal meridian.

4. **Ora serrata:** Peripheral margin of the retina which consists of dentate fringe. The retina ends here and ciliary body stars.

   Here sensory retina is firmly attached to vitreous and RPE

   Servations are less developed temporally where cystic degeneration is most common.

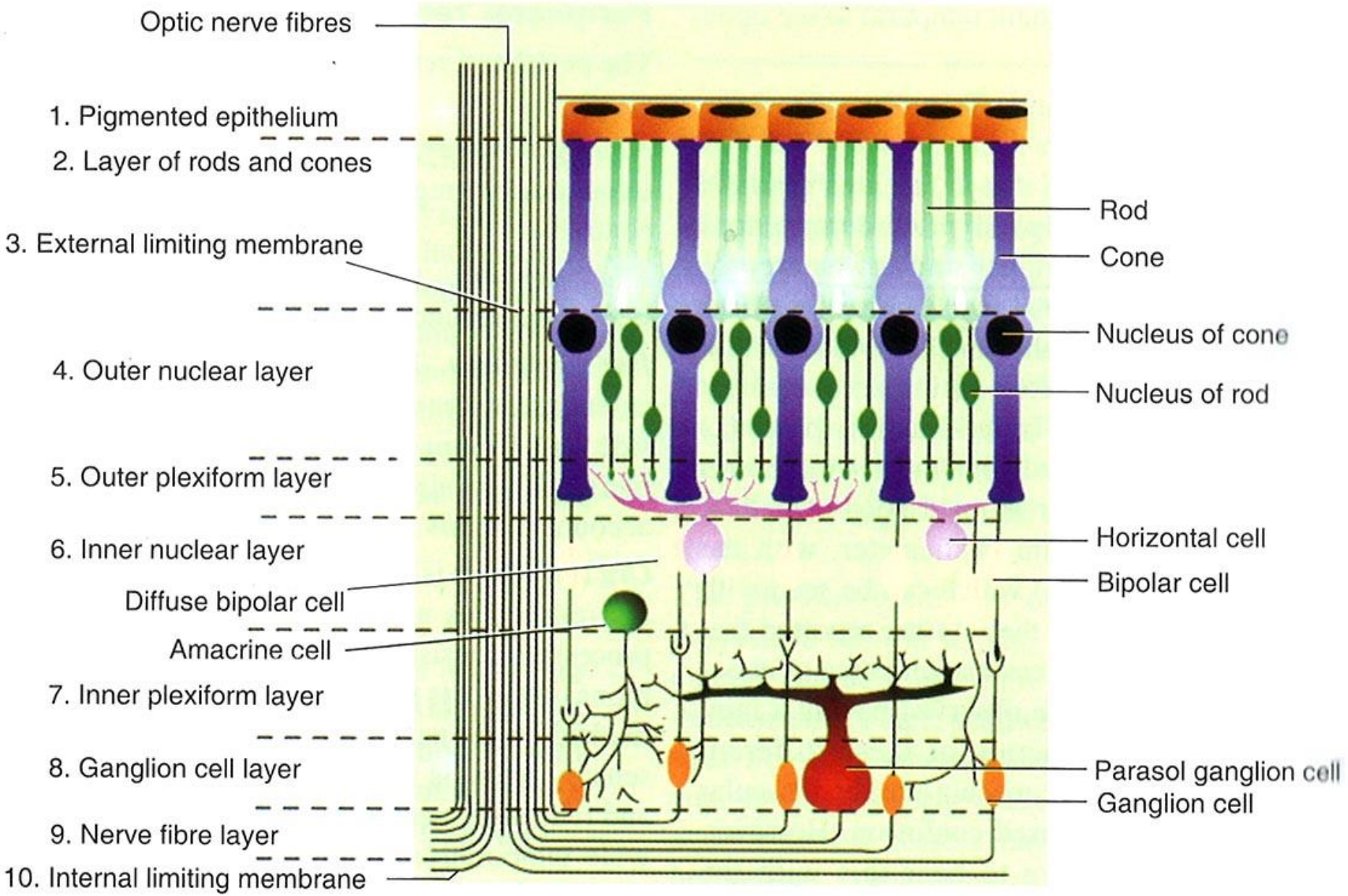


- Ora serrata marks the transition between the attenuated Retina and Inner Columnar Non-Pigment cells of Pars ciliariinues as retinae.
- The RPE continues anteriorly as the outer cuboidal cell layer of the ciliary body.
- Beginning at a younger age the cystoid degeneration starts at the outer plexiform layer , more marked on the nasal side.
- They extend between the inner and the outer limiting membrane in elders and communicate with the vitreous leading to Retinal Detachment.

MICROSCOPIC STRUCTURE OF RETINA

It has 10 layers:

1. Retinal pigment epithelium
2. Layer of rods and cones
3. External limiting membrane
4. Outer nuclear layer
5. Outer molecular (plexiform) layer
6. Inner nuclear layer
7. Inner molecular (plexiform) layer
8. Ganglion cell layer
9. Nerve fibre layer
10. Internal limiting membrane



Microscopic structure of the retina.

RPE:

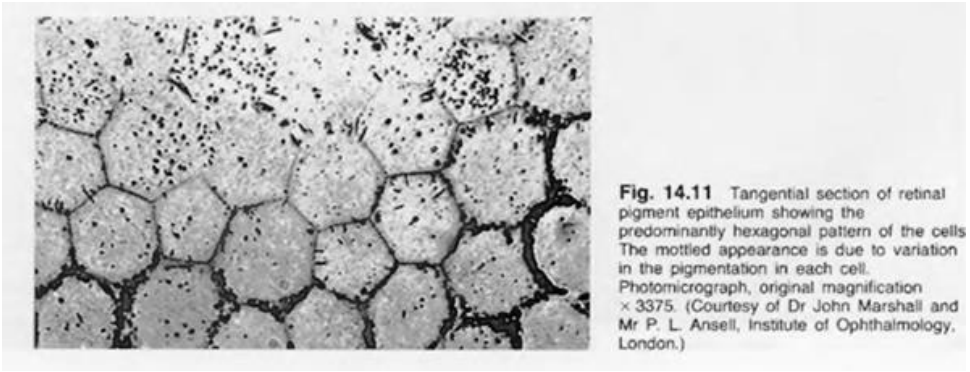


Fig. 14.11 Tangential section of retinal pigment epithelium showing the predominantly hexagonal pattern of the cells. The mottled appearance is due to variation in the pigmentation in each cell. Photomicrograph, original magnification × 3375. (Courtesy of Dr John Marshall and Mr P. L. Ansell, Institute of Ophthalmology, London.)

1. Outer most layer consists of single layer of hexagonal shape cells which contain pigment.
2. It is firmly attached to underlying Bruch's membrane and loosely attached to layer of rods and cones.
3. Space bet. RPE and sensory retina is called sub retinal space. Separation of RPE from sensory retina is called retinal detachment.
4. On electron microscopy the adjacent RPE cells are connected with each other by tight junctions and constitute the outer blood retinal barrier. –Terminal bars.
5. Terminaln bars- (Gap junctons , zonula ocludens and zonula adherens.
6. Zonula ocludens forms the external component of the Blood retinal Barrier.
7. Rest of intercellular space is filled by Extra cellular matrix-VERHOEFF'S MEMBRANE in light microscope

FUNCTIONS:

- Imp. role in photo receptor renewal and recycling of Vit.A.
- Absorption of scattered light by Melanin Granules.
- Transport of nutrients and metabolites through extra retinal blood barrier.
- Inter photo receptor matrix participates in retinal attachment of the retina to RPE and facilitates Phagocytosis of the shed discs of the outer cone segments.
- On the basal surface RPE cells produce type 4 collagen, heparin sulphate and laminin which become incorporated in lamina vitrea of Bruch’s membrane.

Table 14.1 Layers of the retina

1. Pigment epithelium		
2. Photoreceptor layer		
3. External limiting membrane	Neuron I (percipient elements)	Neuroepithelial layer (rod cell, cone cell)
4. Outer nuclear layer		
5. Outer plexiform layer		
6. Inner nuclear layer	Neuron II (conductive and associative elements)	Cerebral layer (bipolar, ganglion, horizontal, and amacrine cells, centrifugal bipolars Müller fibres, astrocytes)
7. Inner plexiform layer		
8. Ganglion cell layer		
9. Nerve fibre layer	Neuron III (conductive elements)	
10. Internal limiting membrane		

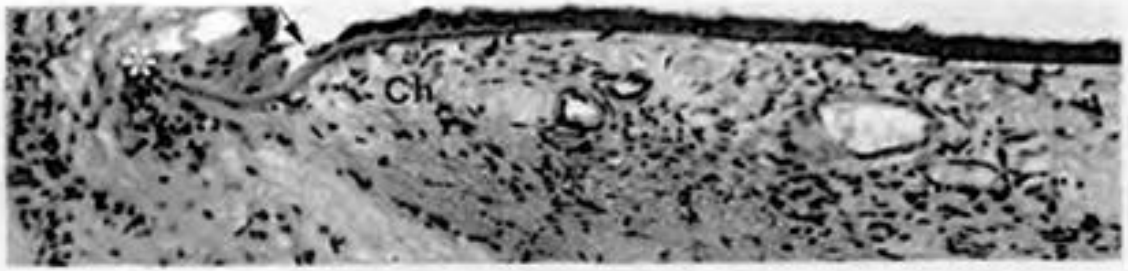
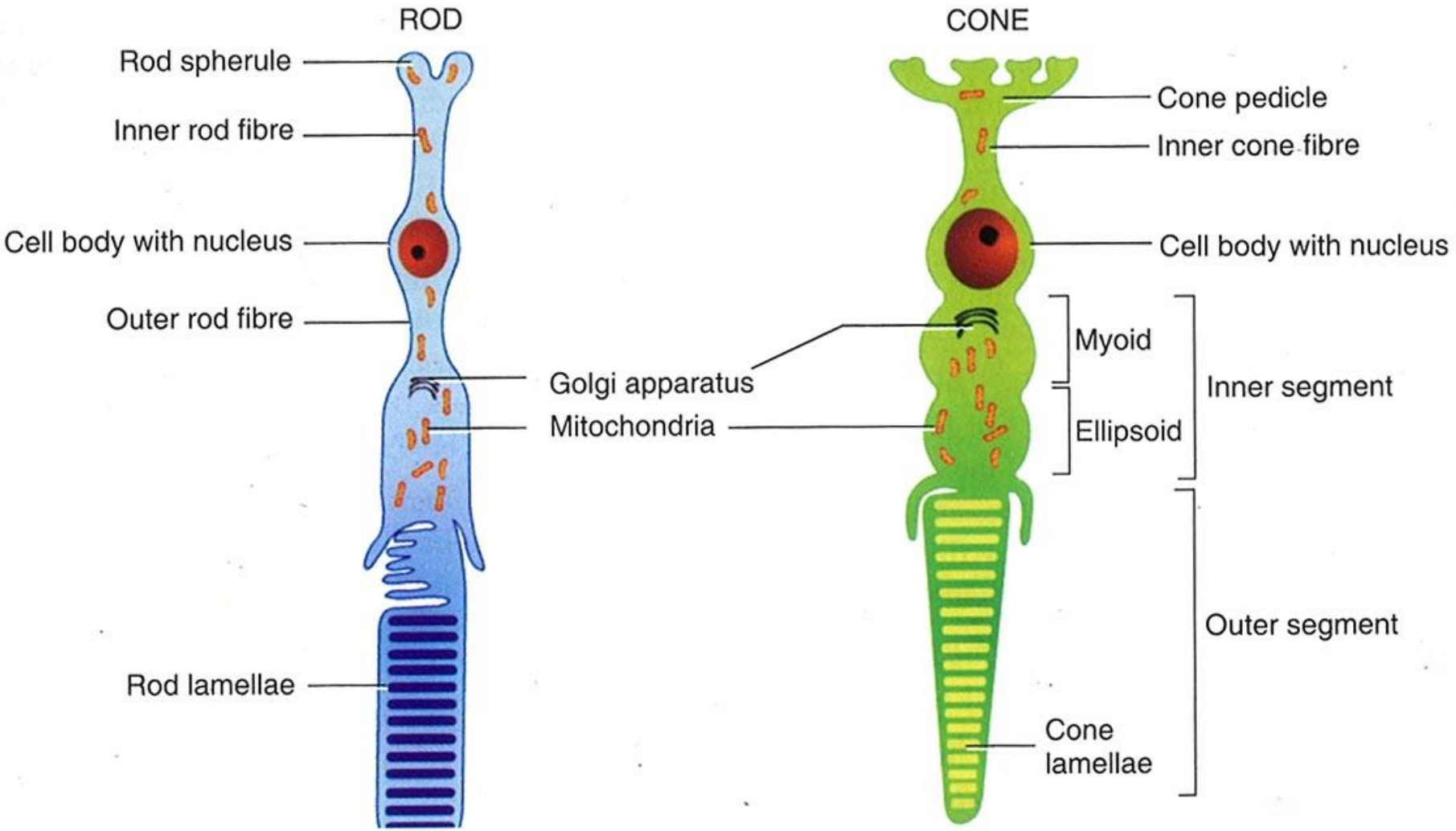


Fig. 14.8 Termination of Bruch's membrane at the edge of the optic disc (asterisk). Note that the pigment epithelium falls short of the termination (arrow), but the choroid (Ch) continues further medially. Photomicrograph, original magnification × 195. (From Tripathi, R. C. and Tripathi, B. J. in Davson, H. (ed.) (1984) *The Eye*, published by Academic Press.)

LAYER OF PHOTO RECEPTORS:

There are about 120 million rods and 6.5mm cones.

1. End organs of vision which transform light energy to visual impulse.
2. Rods contain photo sensitive substance rhodopsin which is responsible for peripheral vision and vision of low illumination.
3. Cones also contain a photo sensitive substain responsible for central vision and colour vision.
4. Highest density of cones is at fovea.
5. Rods are absent at fovea and maximum below the optic disc.

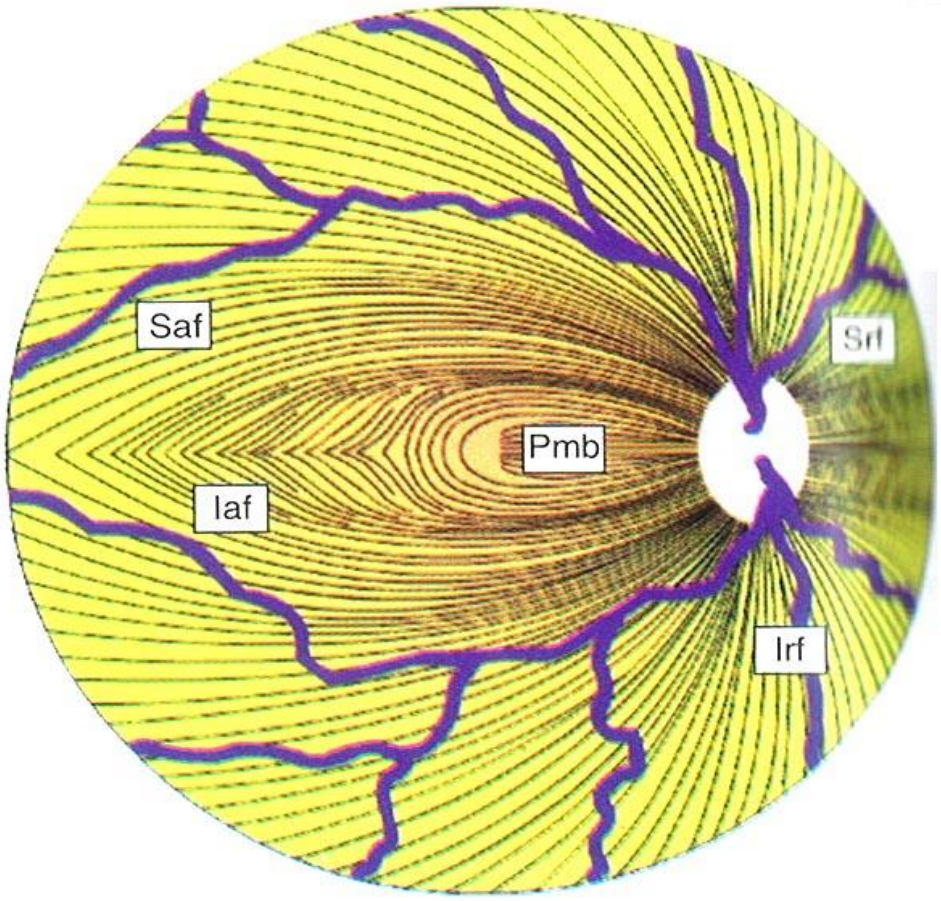


Microscopic structure of a rod cell.

Microscopic structure of a cone cell.

ARRANGEMENT OF NERVE FIBRES IN THE RETINA:

1. Fibres from the nasal half of the retina come directly to the optic disc as superior and inferior radiating fibres (srf and irf).
2. Fibres from the macular region pass straight in the temporal part of the disck as papillomacular bundle (pmb).
3. Fibres from the temporal retina arch above and below the macular and papillomacular bundle as superior and inferior arcuate fibres (saf and iaf) with a horizontal raphe in between.



Arrangement of nerve fibres in the retina

ARRANGEMENT OF NERVE FIBRES OF THE OPTIC NERVE HEAD:

Fibres form the peripheral part of the retina lie deep in the retina but occupy the most peripheral (superficial) part of the optic disc. While the fibres originating closer to the optic nerve head lie superficially in the retina and occupy a more central (deep) portion of the disc.

THICKENSS OF NERVE FIBRE LAYER AT THE DISC:

Thickness of the nerve fibre layer around the different quadrants of the optic disc margin progressively increases in the following order:

Most lateral quadrant (thinnest)

Upper temporal and lower temporal quadrant

Most medial quadrant

Upper nasal and lower nasal quadrant (thickest)

CLINICAL SIGNIFICANCE OF DISTRIBUTION AND THICKNESS OF NERVE FIBRES AT THE OPTIC DISC MARGIN:

1. Papilloedema appears first of all in the thickest quadrant (upper nasal and lower nasal) and last of all in the thinnest quadrant (most lateral).
2. Arcuate nerve fibres which occupy the superior temporal and inferior temporal quadrants of optic nerve head are most sensitive to glaucomatous damage, accounting for an early loss in corresponding regions of visual field.
3. Macular fibres occupying the lateral quadrant are most resistant to glaucomatous damage and explain the retention of the central vision till end.

BLOOD SUPPLY OF THE RETINA:

•Outer 4 layers of retina is supplied by (till outer nuclear layer) choriocapillaries.

•The inner six layers gets its supply from central retinal artery which is a branch of ophthalmic artery.

•The outer plexiform layer gets partly by both the above arteries.

•The fovea is avascular and is mainly supplied by choriocapillaries.

•The inner portion of the retina is perfused by branches of the central retinal artery. (cherry red spot in CRAO occurs due to choroidal circulation visible at fovea)

•In 30% of eyes ,a cilioretinal artery, branching from the ciliary circulation ,supplies part of inner retina mainly The Macula Region.

•The retinal blood vessels maintain the inner blood-retinal barrier.This physiological barrier is due to single layer of non-fenestrated endothelial cells,whose tight junctions are impervious to tracer substances such as fluorescein.

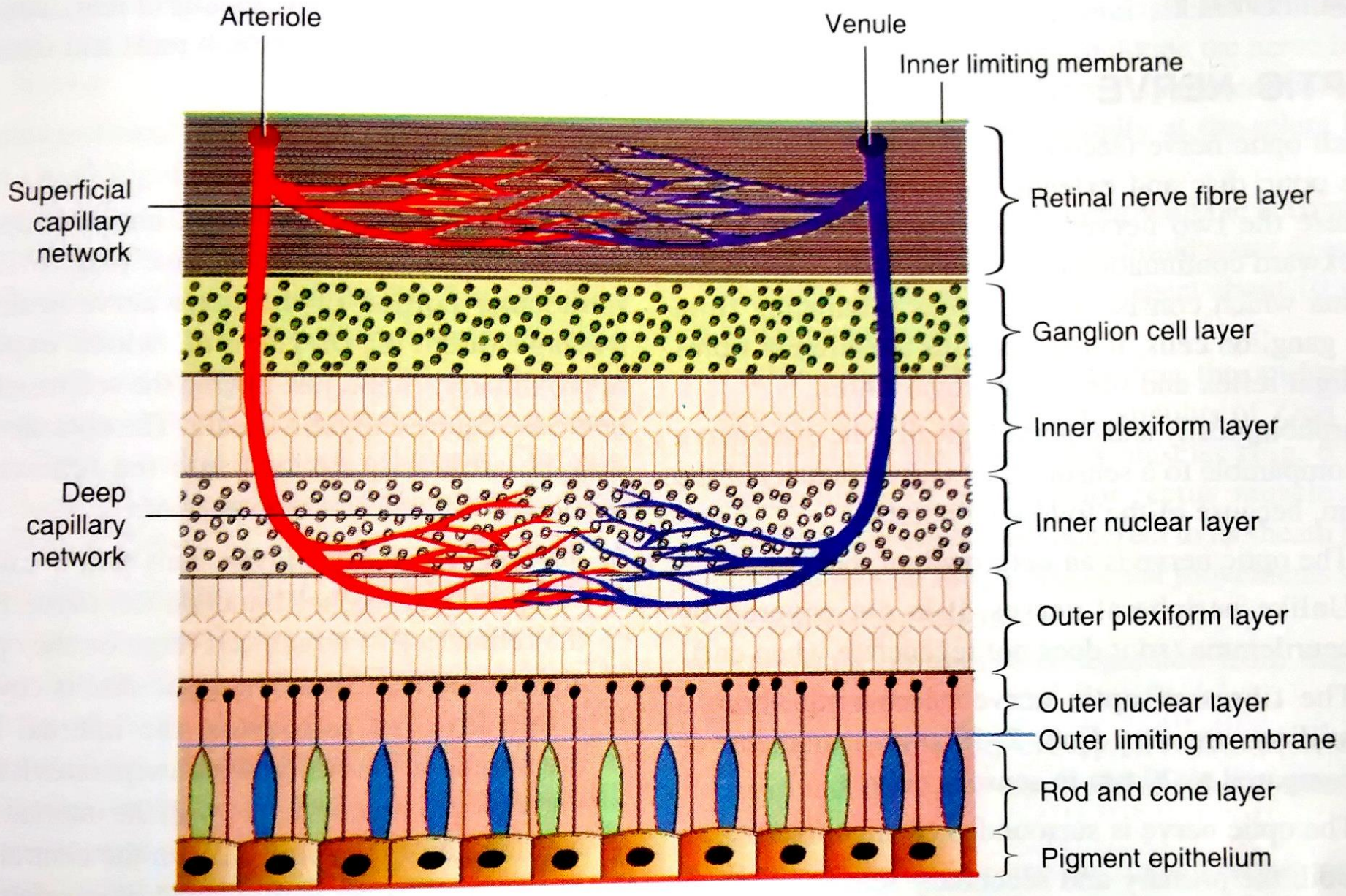


Fig. 6.11. Arrangement of retinal capillaries.

•Retinal blood vessels lack an internal elastic lamina & a continuous layer of smooth muscle cells.

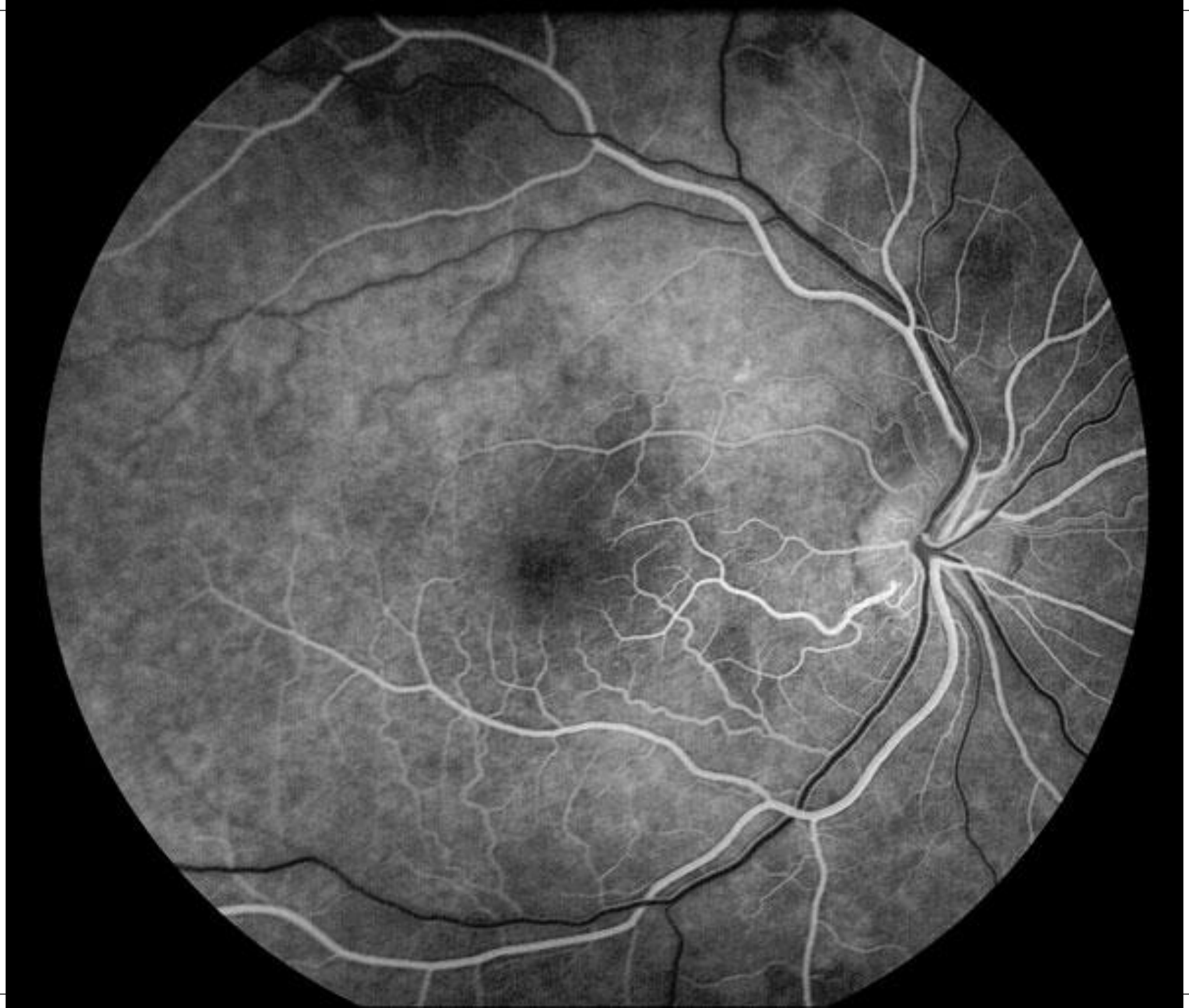
•The retinal arteries are end arteries & have no anastomoses.The only place where the retinal system anastomoses is in the neighbourhood of lamina cribrosa.

•The veins of the retina unite to form Central retinal vein at the disc, which follows the corresponding artery.

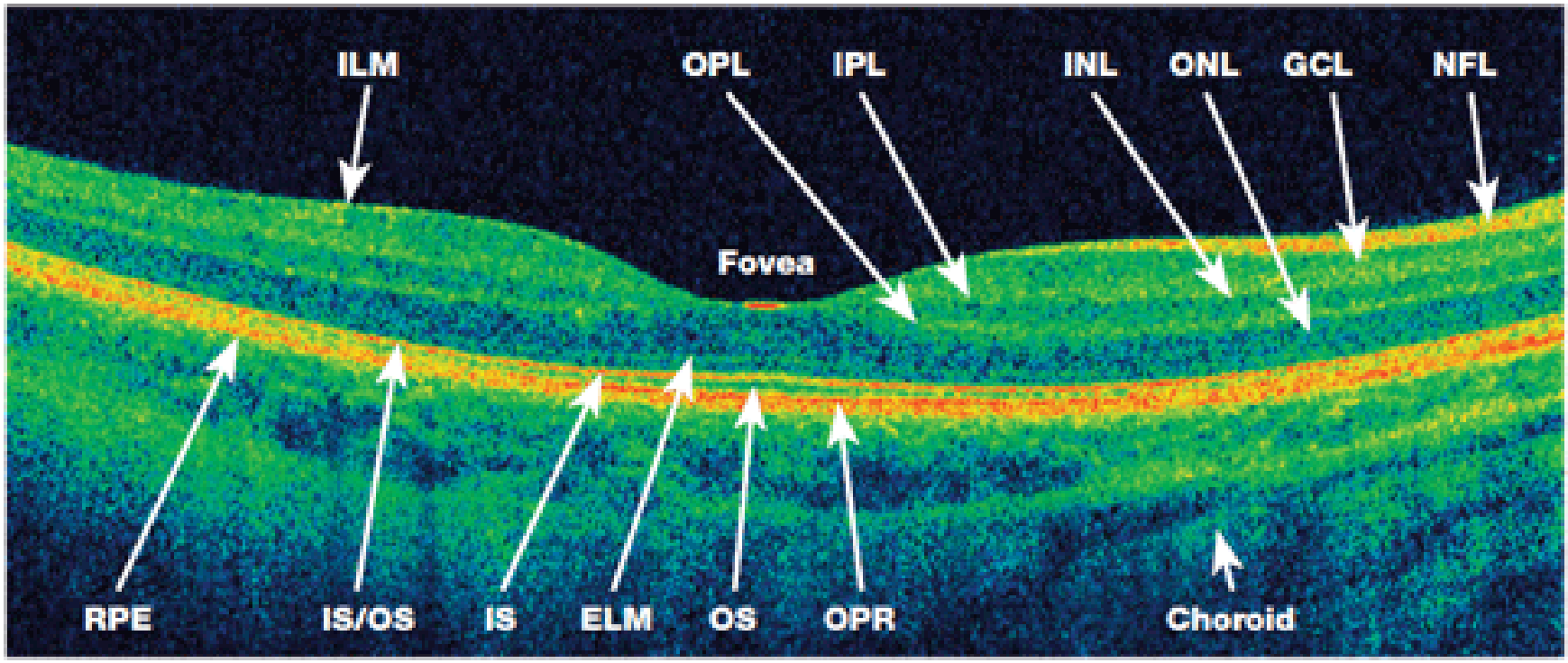
•A capillary free zone of 500miceo metre diameter in foveal zone- FAZ.

Blood Retinal Barrier.

- Outer BRB formed by tight junctions between the pigment epithelial cells in RPE.
- Inner BRB Formed by the endothelial cells that are closely bound together about the lumen by intercellular junctions of zonula occludens type.
- These junctions normally prevent the free flow of fluids and solutes.
- The endothelial cells are encircled by basement membrane and which is surrounded by layer of pericytes- which is further surrounded by basement membrane.



An HD-OCT scan of a healthy eye



NFL: Nerve fiber layer
ILM: Inner limiting membrane
GCL: Ganglion cell layer
IPL: Inner plexiform layer
INL: Inner nuclear layer

OPL: Outer plexiform layer
ONL: Outer nuclear layer
ELM: External limiting membrane
IS: Photoreceptor inner segment
OS: Photoreceptor outer segment

IS/OS: Interface between IS and OS
RPE: Retinal pigment epithelium
OPR: Outer photoreceptor/ RPE complex

Anatomy of vitreous

VITREOUS HUMOR

- is an inert, transparent, jelly-like structure that fills the posterior 4/5 of the cavity of the eyeball
- normal volume – 4 mL
- hydrophilic gel with optical functions
- mechanically stabilizes the volume of the globe
- pathway for nutrients to reach the lens and retina

STRUCTURE OF THE VITREOUS

- composed of a network of randomly-oriented collagen fibrils interspersed with numerous spheroidal macromolecules of hyaluronic acid
- colapse = conversion of gel into sol
- can be divided into**: cortex** and **nucleus** (main vitreous body)

CORTICAL VITREOUS

- lies adjacent to the retina posteriorly & to the lens, ciliary body and zonules anteriorly
- density of collagen fibrils is greater in the peripheral part
- condensation of these fibrils form false anatomic membranes: anterior hyaloid membrane and posterior

CORTICAL VITREOUS

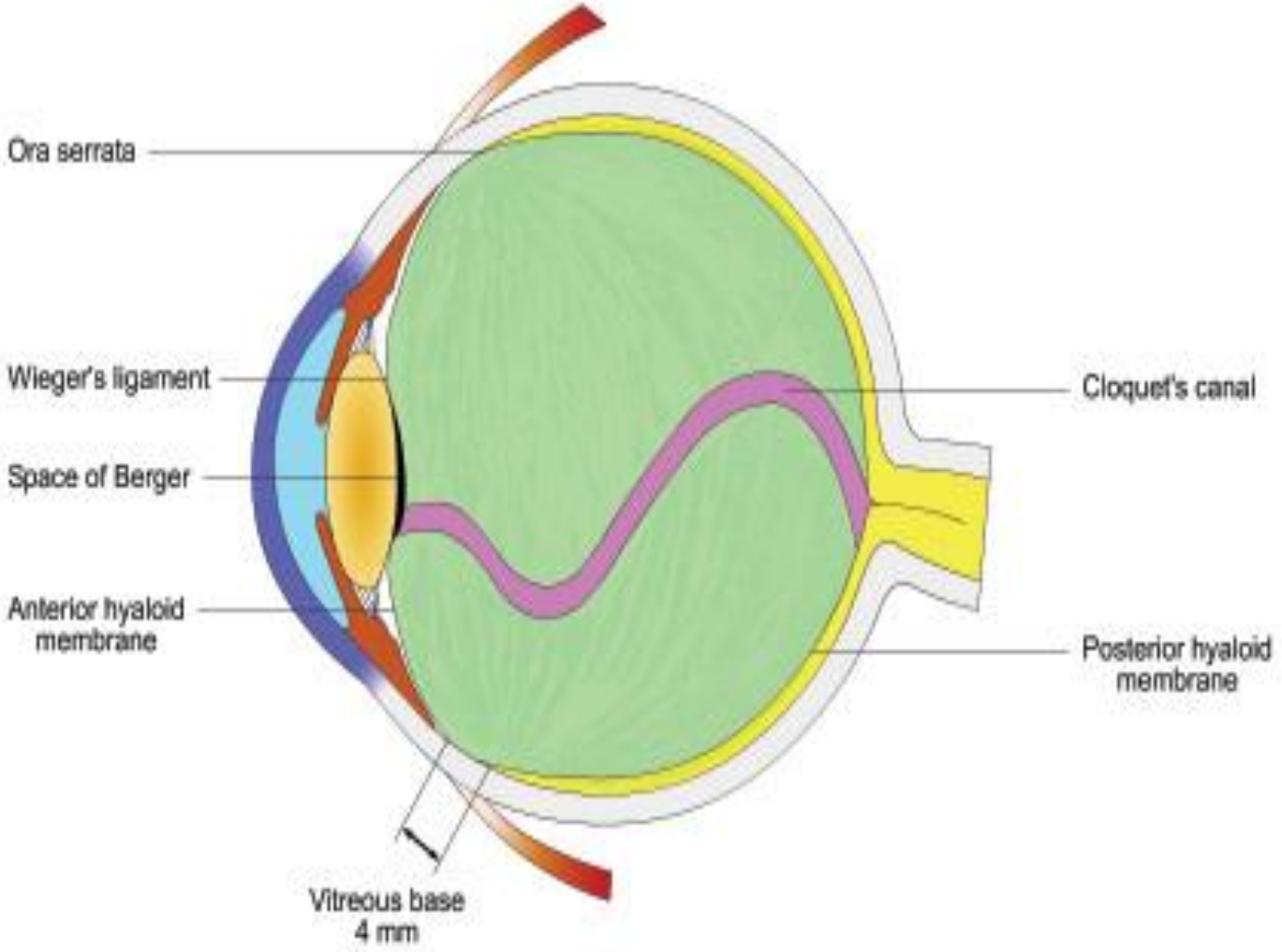
- anterior hyaloid membrane is attached to the posterior lens
- posterior hyaloid membrane is loosely attached to the internal limiting membrane of the retina

MAIN VITREOUS BODY (NUCLEUS)

- it has less dense fibrillar structure
- true biological gel
- site where liquefaction of the vitreous gel starts first
- Hyaloid canal (Cloquet's Canal) – Hyaloid artery of the fetus

Attachments of vitreous

- **VITREOUS BASE** – part of the vitreous about 4 mm across the ora serrata where the attachment is strongest.
- other firm attachments – around the margins of the optic disc, foveal region and back of the crystalline lens (ligament of Wieger)


Ora serrata
Wieger's ligament
Space of Berger
Anterior hyaloid membrane
Cloquet's canal
Posterior hyaloid membrane
Vitreous base 4 mm


THANK YOU