

The Body Works?

Part 2

Part of the UVic
Retirees Association (UVRA)
Elder Academy Program

*Presenters: David Docherty, Ph.D., with
Chris Pengilly, M.D., Mike Bassett, M.D.
and Dr. Helen Martindale, Ph.D., O.D.*

Presentations: in two parts

1. The anatomy and function of **four new** selected systems
2. Things that can go wrong and the **medical interventions** commonly available

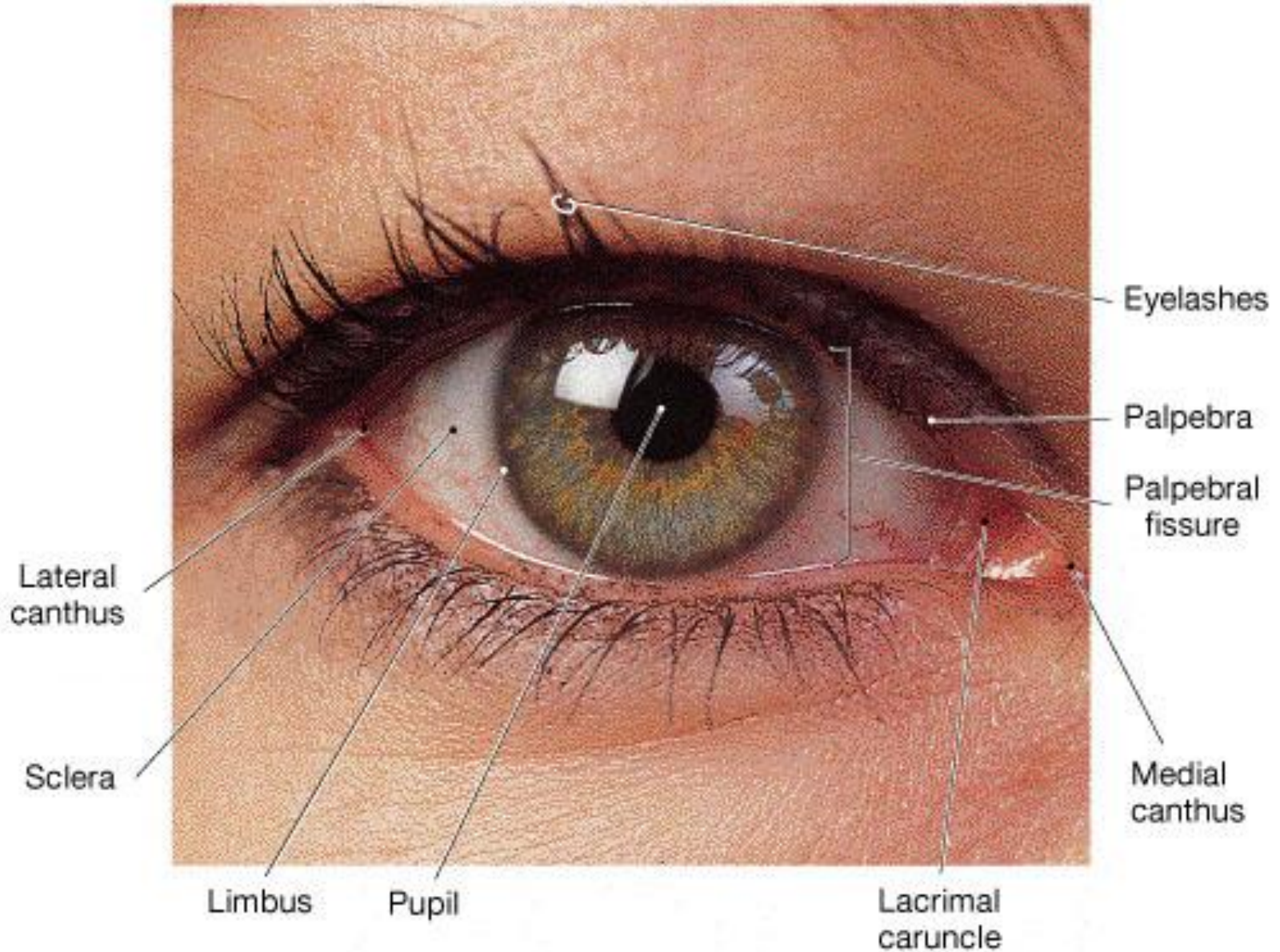
Reminder: Slide presentations available:

<https://onlineacademiccommunity.uvic.ca/elderacademy>

4 New Systems

- ~~• The Brain-Dr. Mike Bassett~~
- ~~• The Endocrine System-Dr. Chris Pengilly~~
- ~~• The Respiratory System-Dr. Chris Pengilly~~
- The Special Senses (Vision)-Dr Helen Martindale

The Eye and Vision

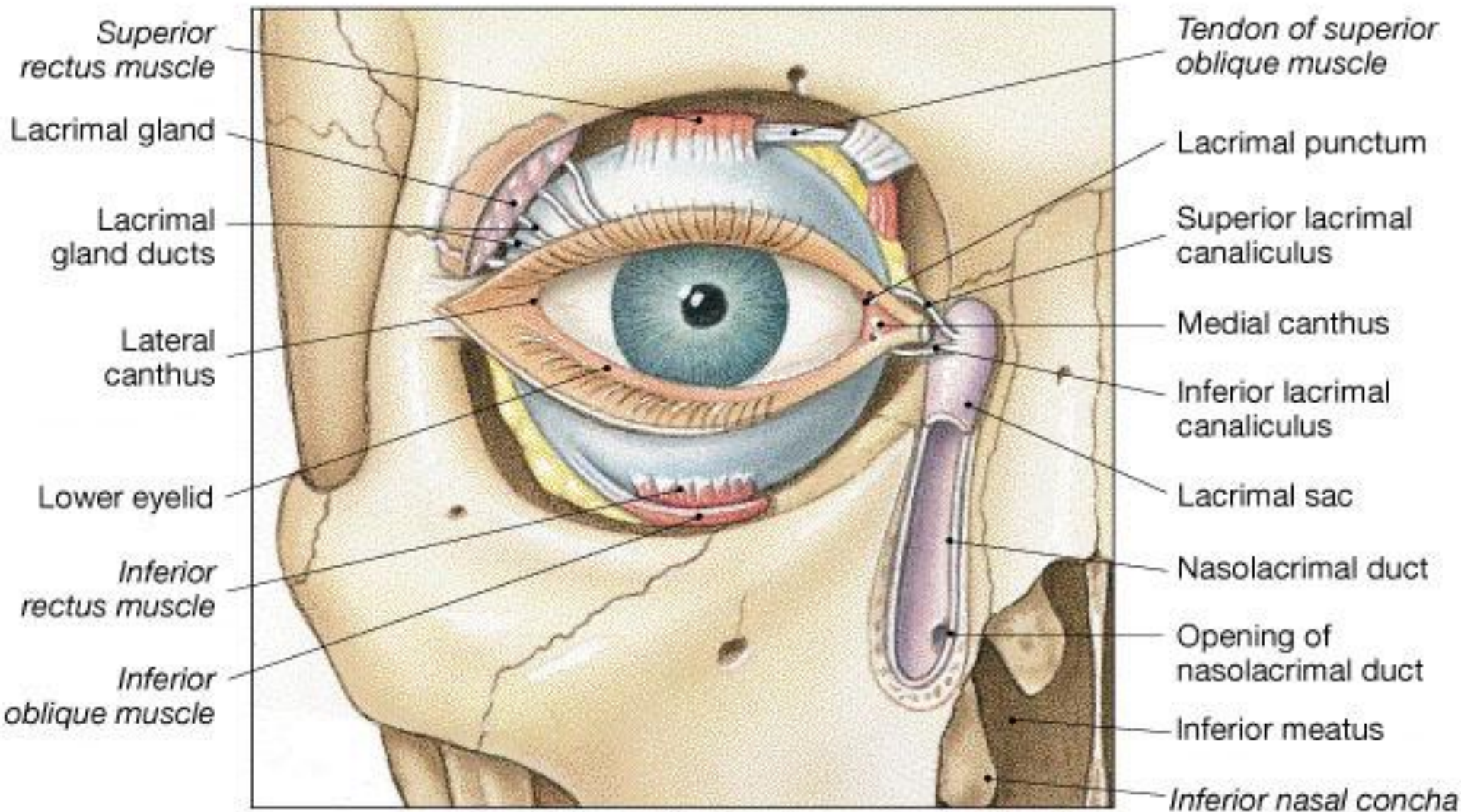


(a) Right eye, accessory structures

Overview of presentation

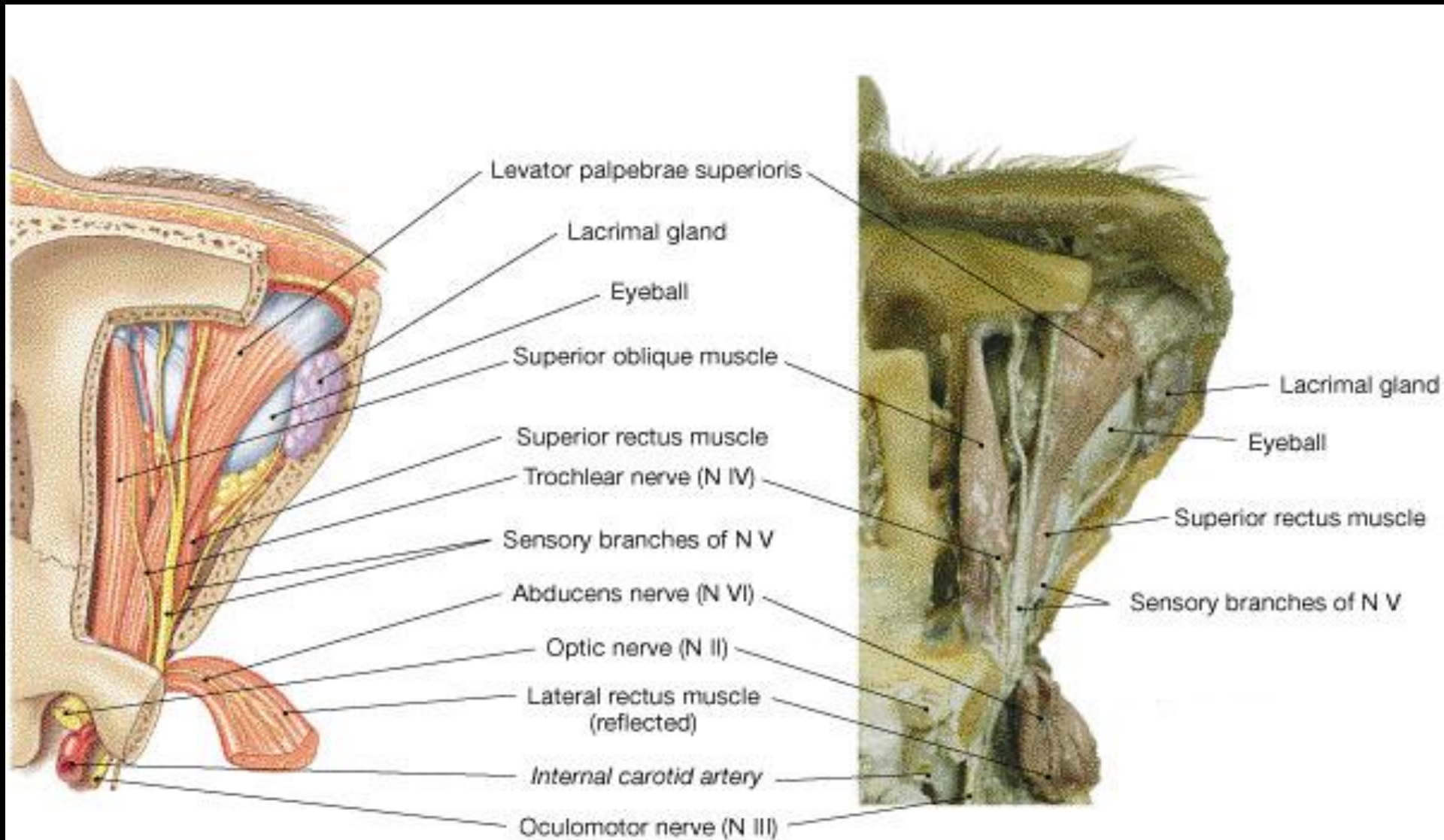
- Basic anatomy of the eye
- How the eyes see/work
- How the eyes are examined
- Some of the more common conditions related to aging (and maybe a few less common ones!)
- Possible treatments to the common conditions

Accessory Structures



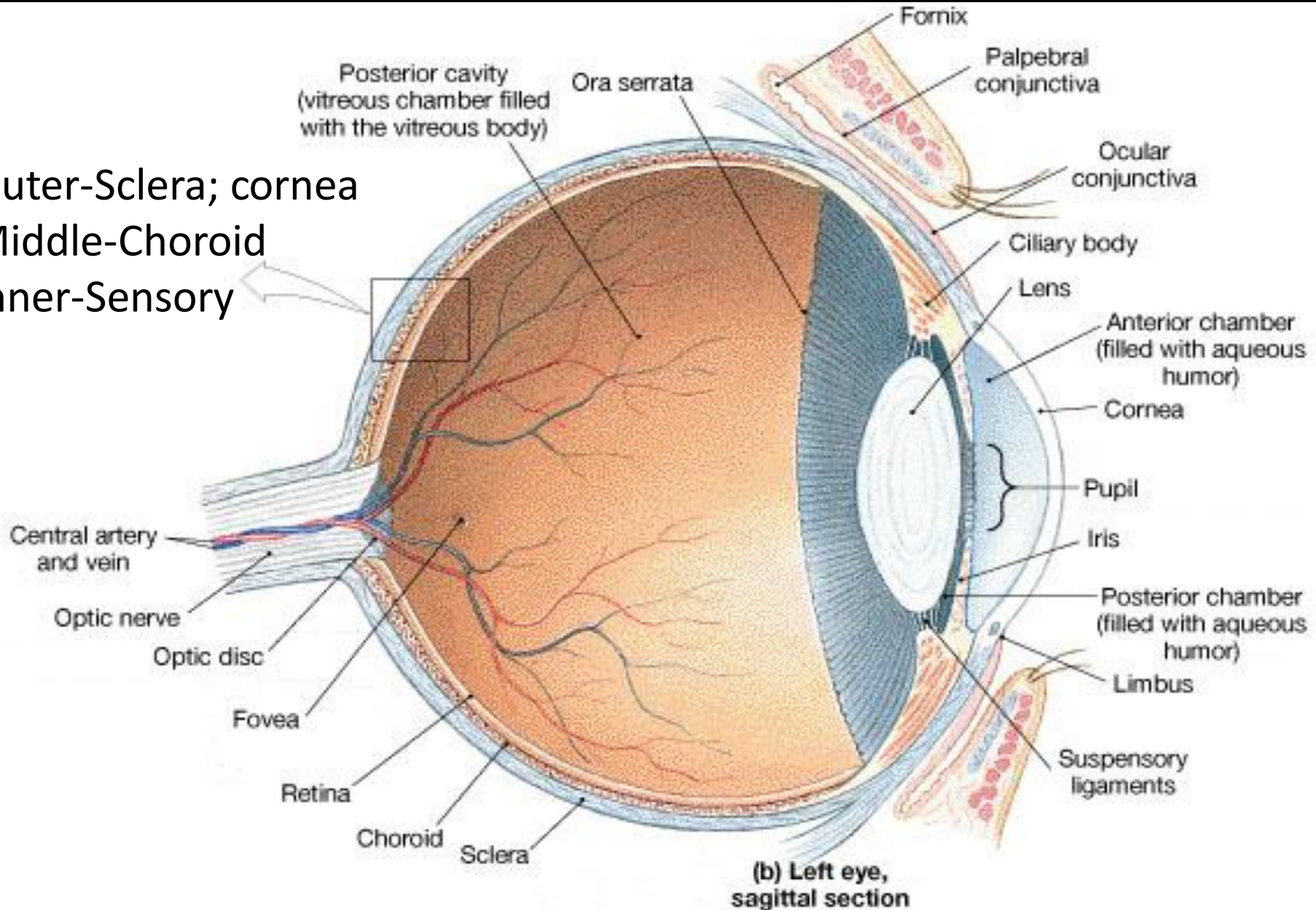
(b) Dissection of right orbit

Accessory structures

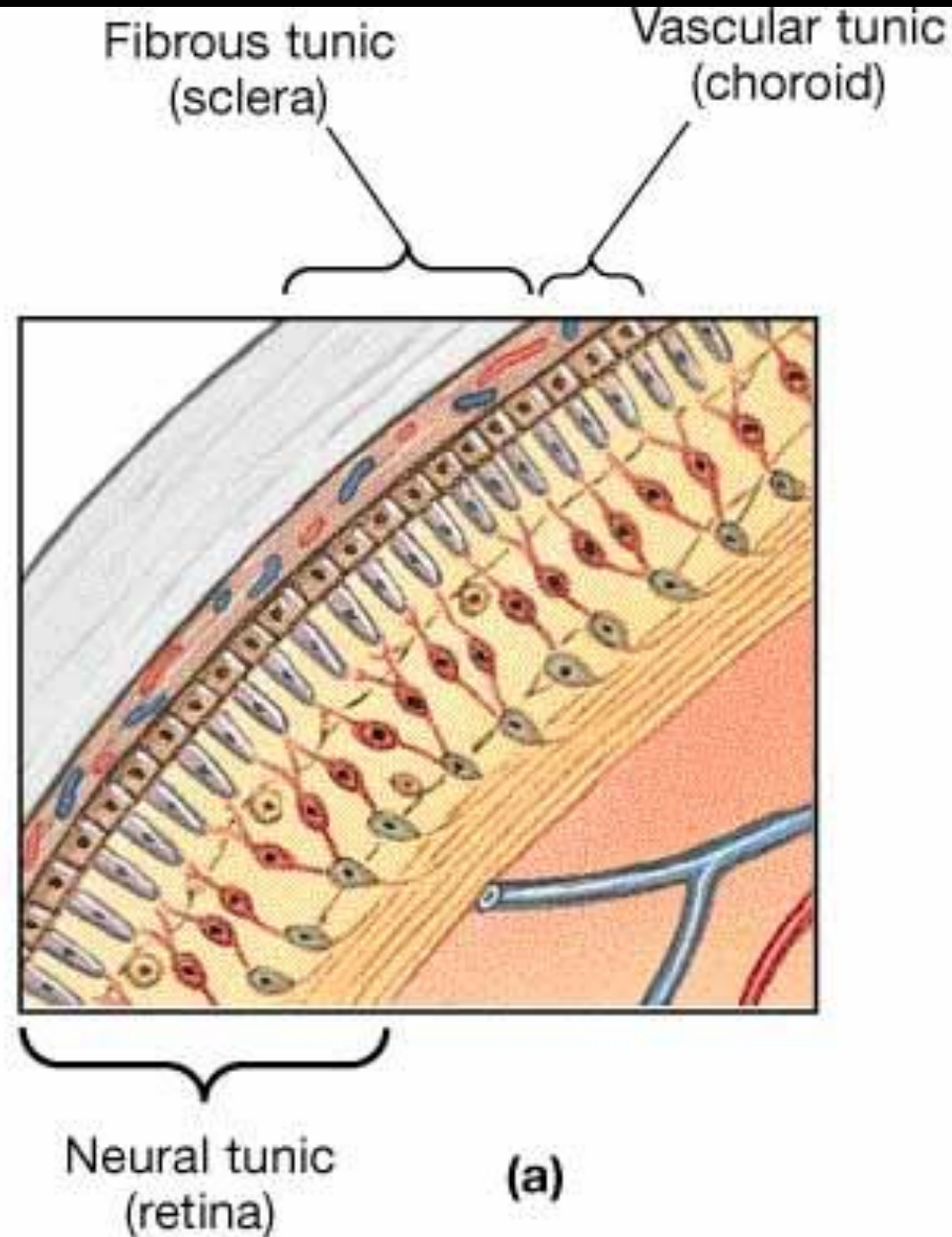


The Layers of the Eye!

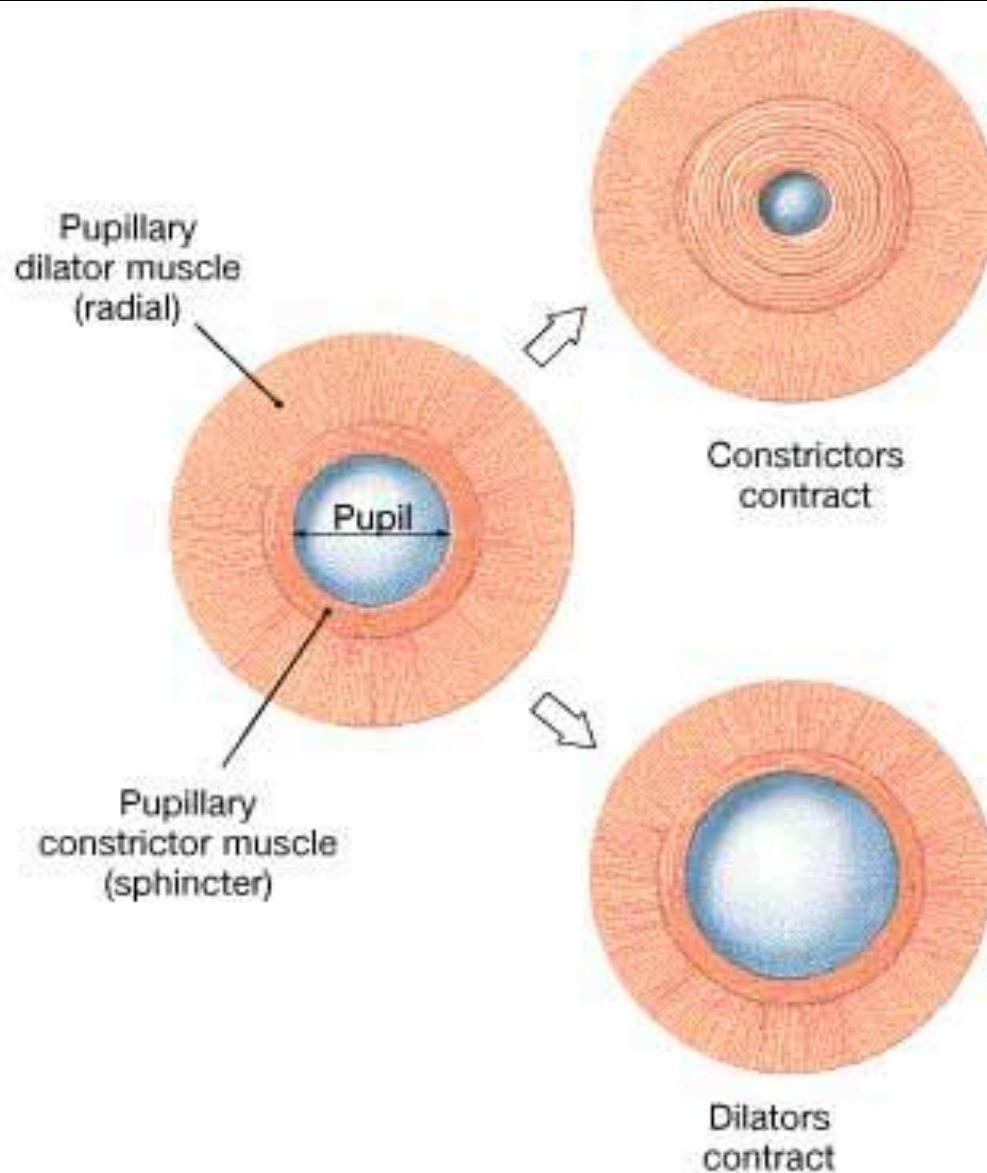
- Outer-Sclera; cornea
- Middle-Choroid
- Inner-Sensory



The 3 Layers of the Eye

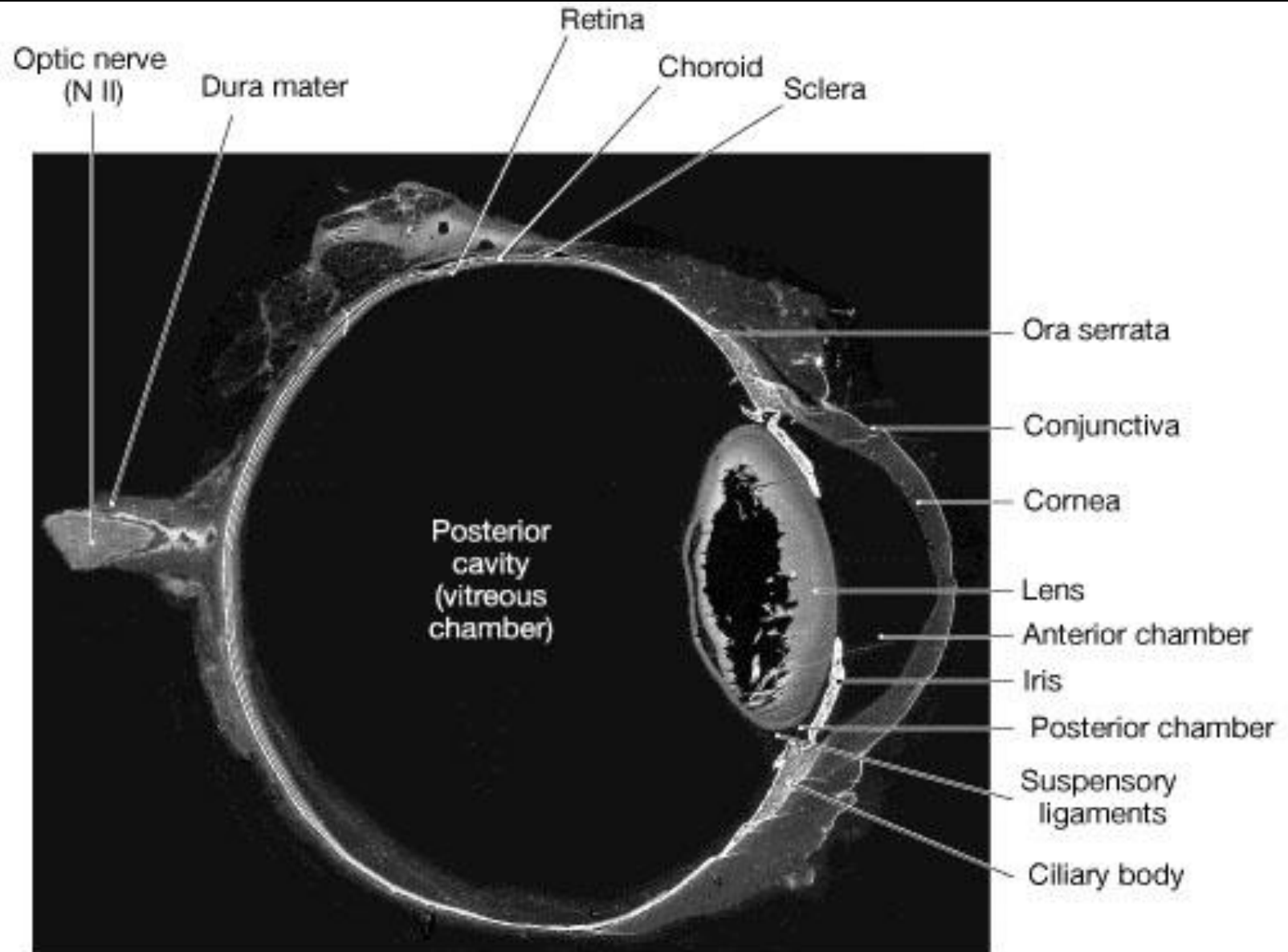


Action of the pupillary m. of the eye



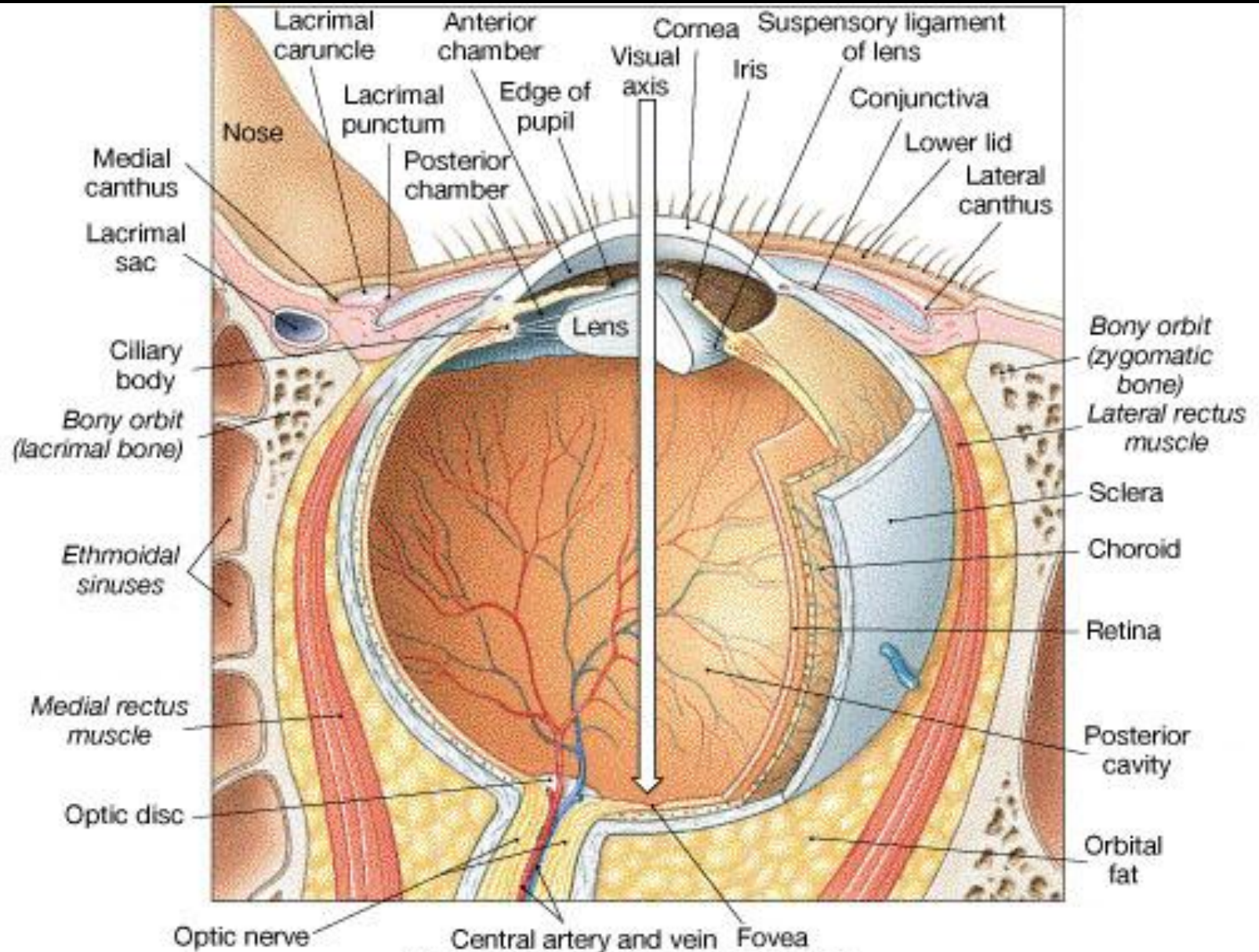
(c) Action of pupillary muscles

X Ray of Cross Section



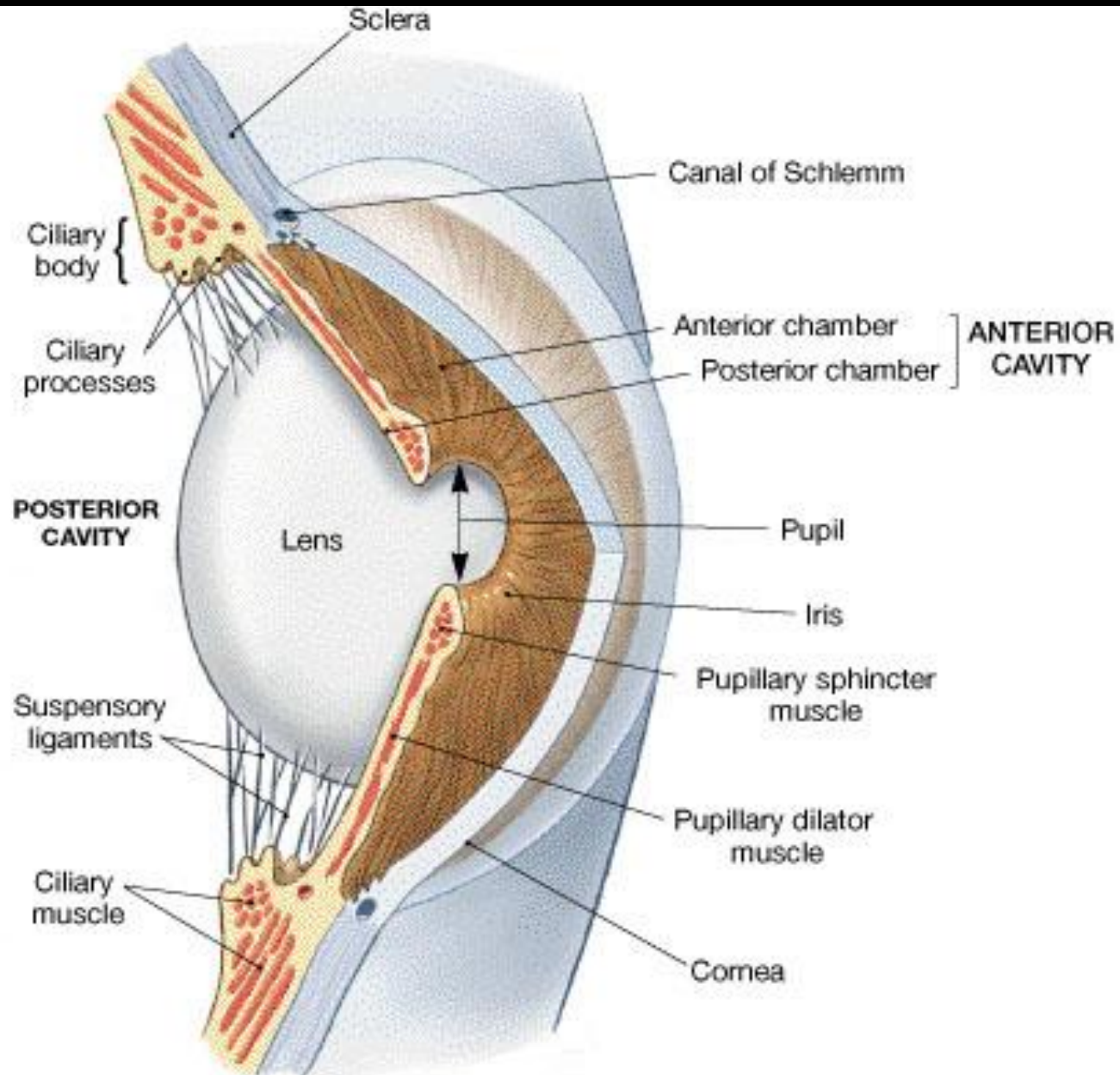
(d) Sagittal section

Bird's Eye View

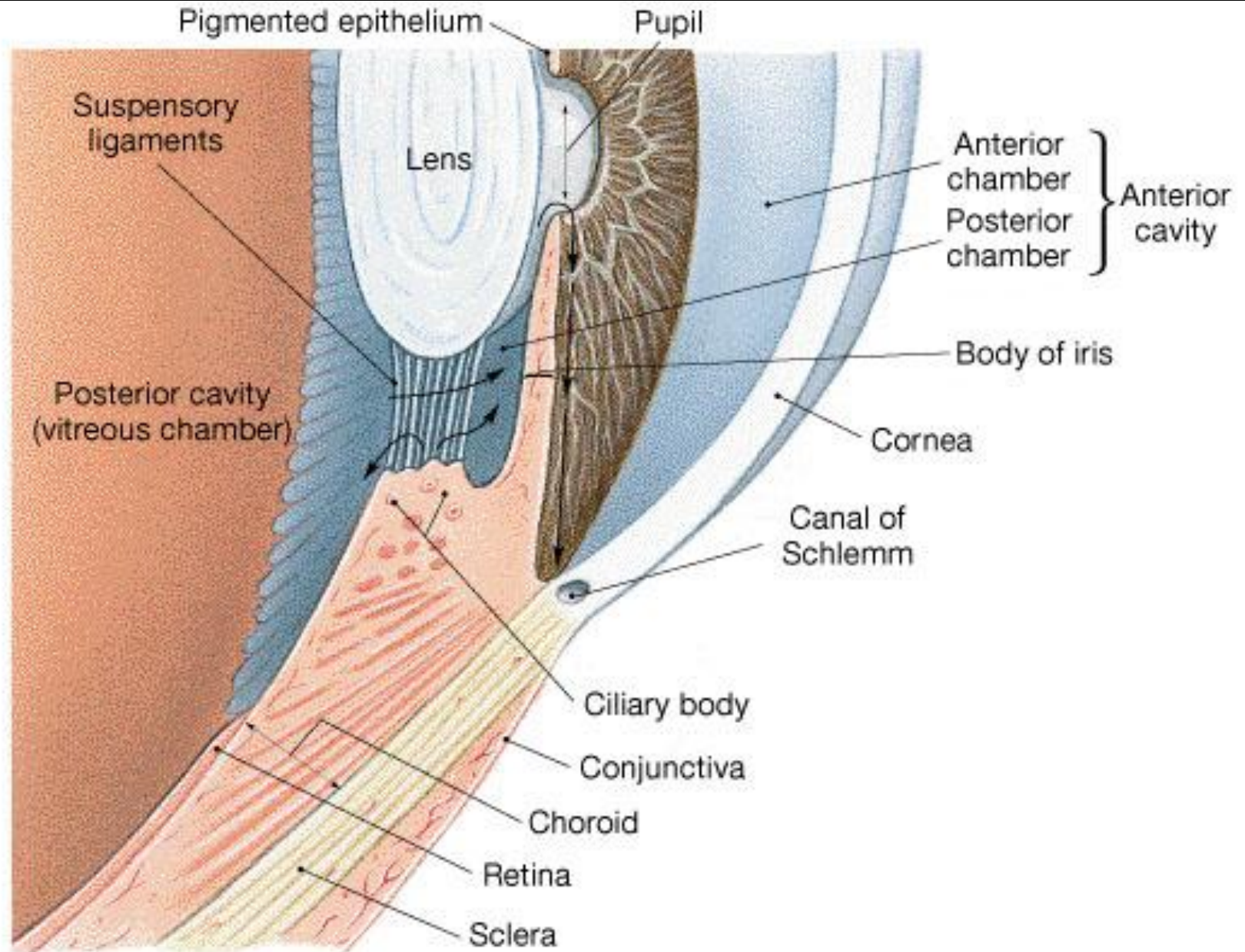


(e) Horizontal section, superior view

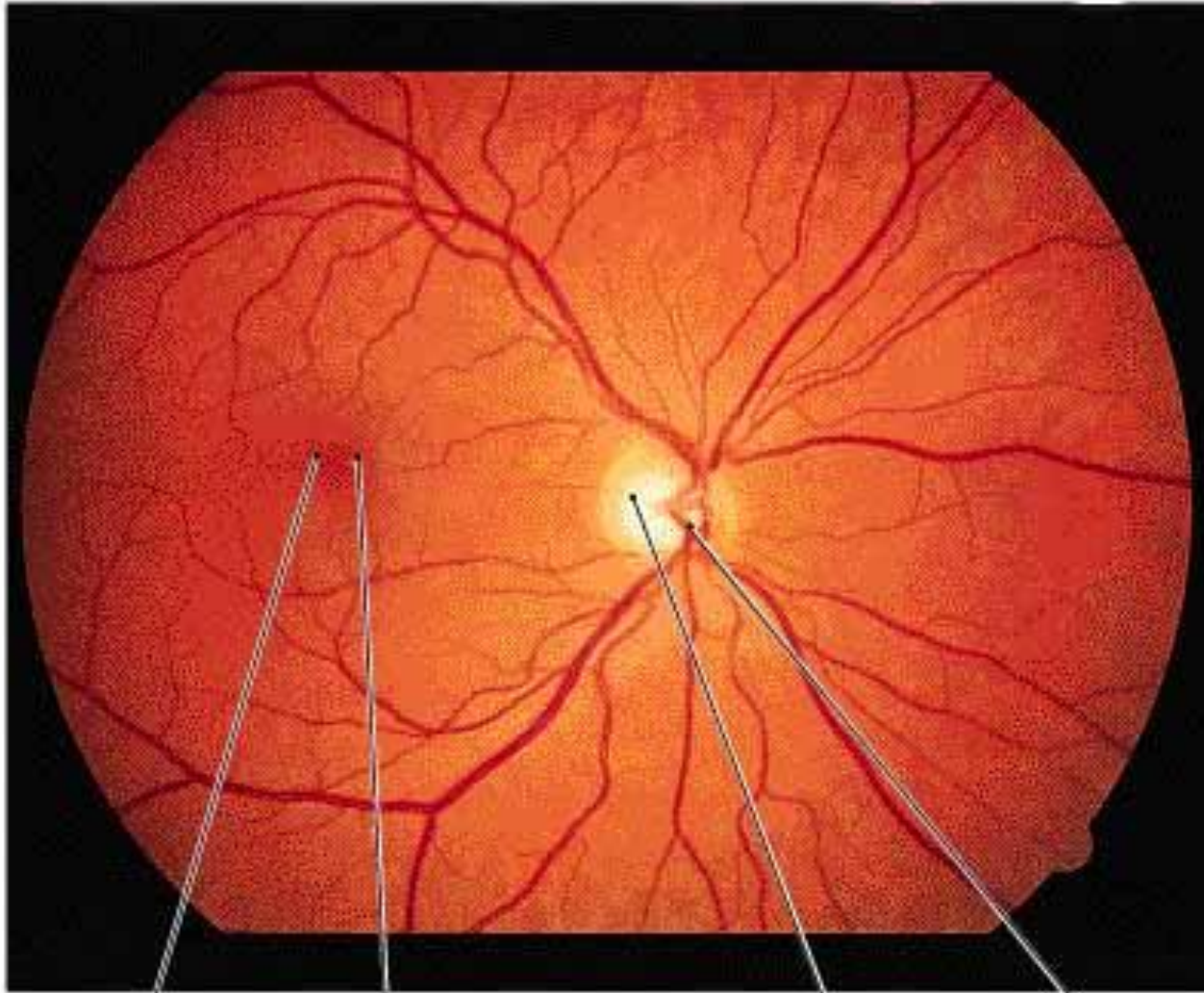
Chambers of the Eye



Circulation of the Aqueous Humor



Photograph taken through the Pupil



Macula
lutea

Fovea

Optic disc
(blind spot)

Central retinal
artery and vein
emerging from
center of
optic disc

Anatomy

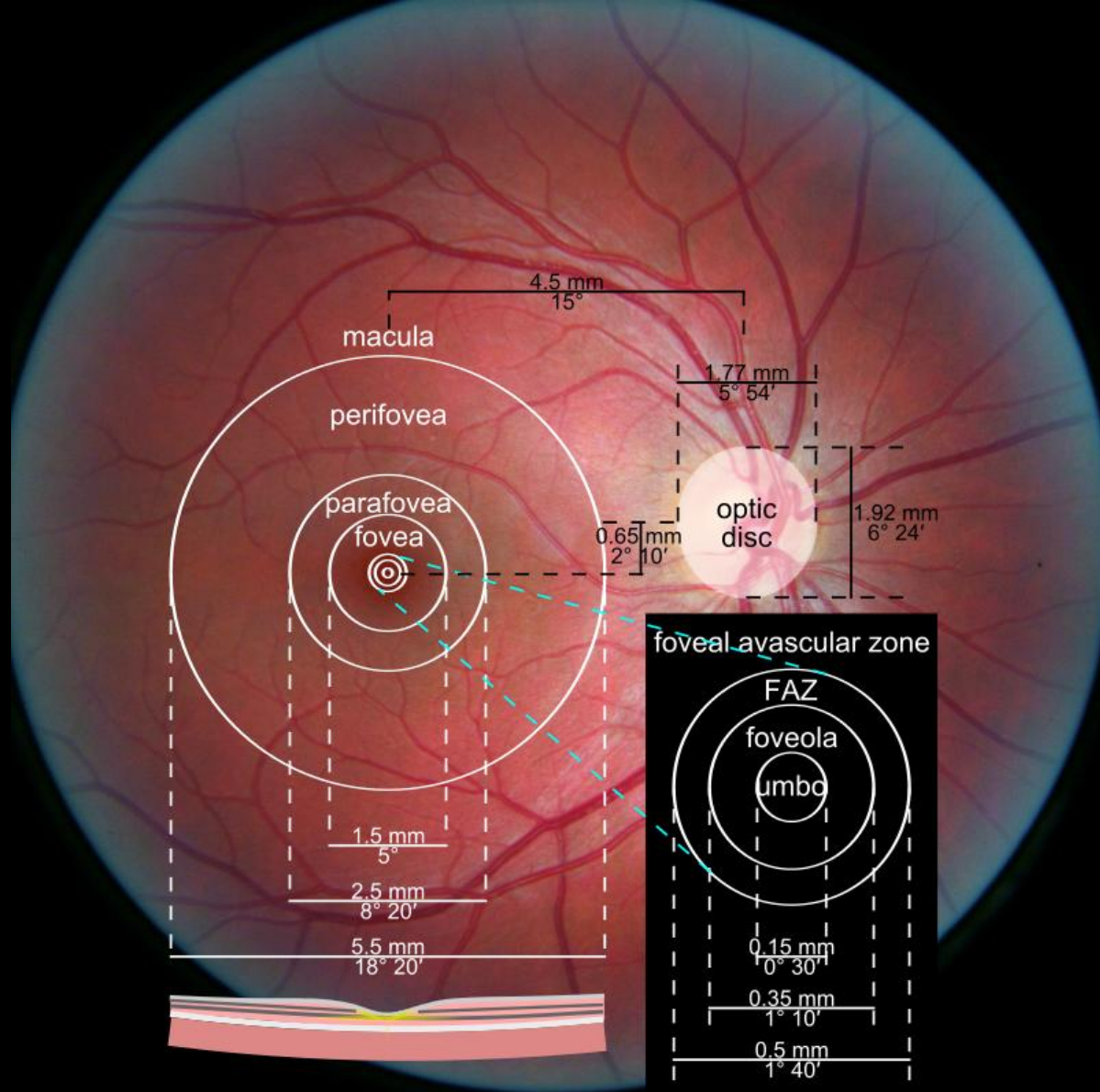
- **Macula** (High acuity vision)
 - Diameter 5 mm
 - 4 mm temporal, 0.8 inferior to optic disc
- **Fovea** (Centre of the macula)
 - Depression of ~1 disc diameter (1.5 mm) at centre of macula

From: Dr. Charlotte Hazel

Anatomy

- **Foveola** (Also within the macula)
 - Central point of fovea
 - 0.35 mm in diameter
 - Thinnest part of retina
 - Cones only
 - High levels of visual acuity

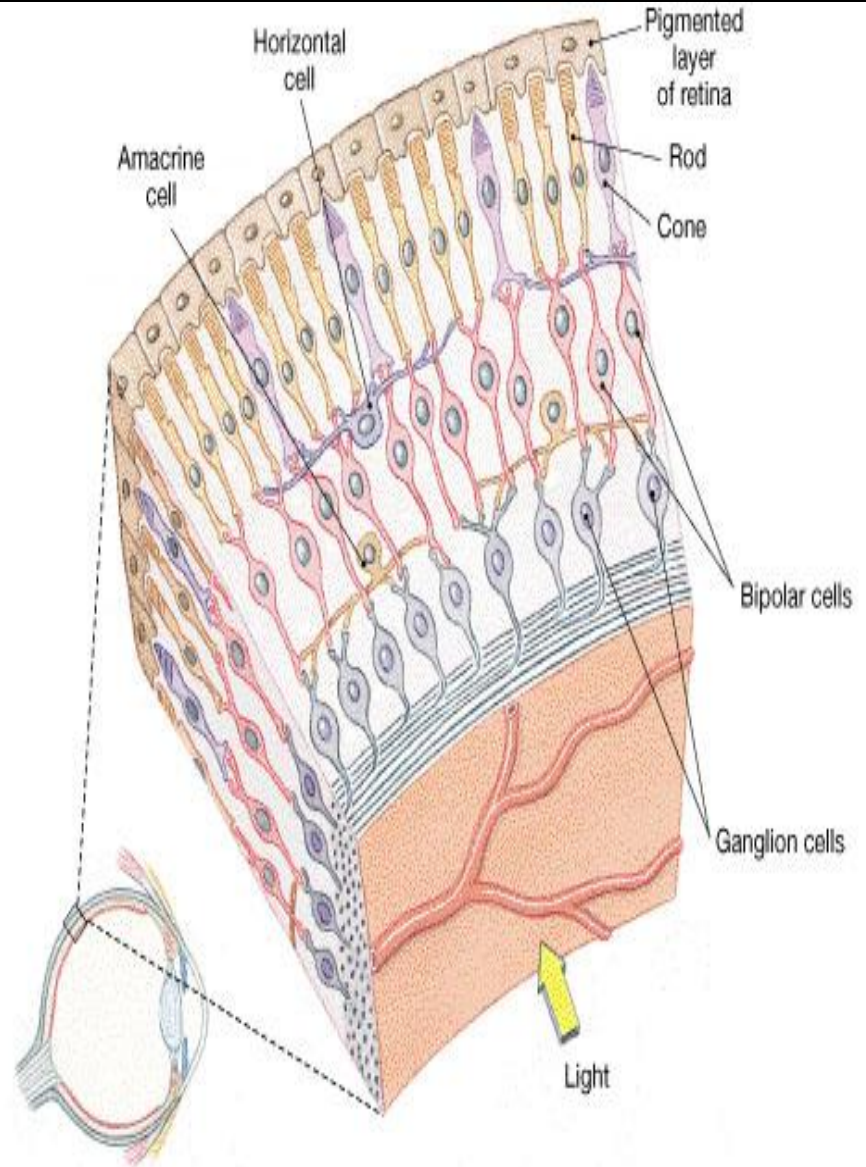
From: Dr. Charlotte Hazel



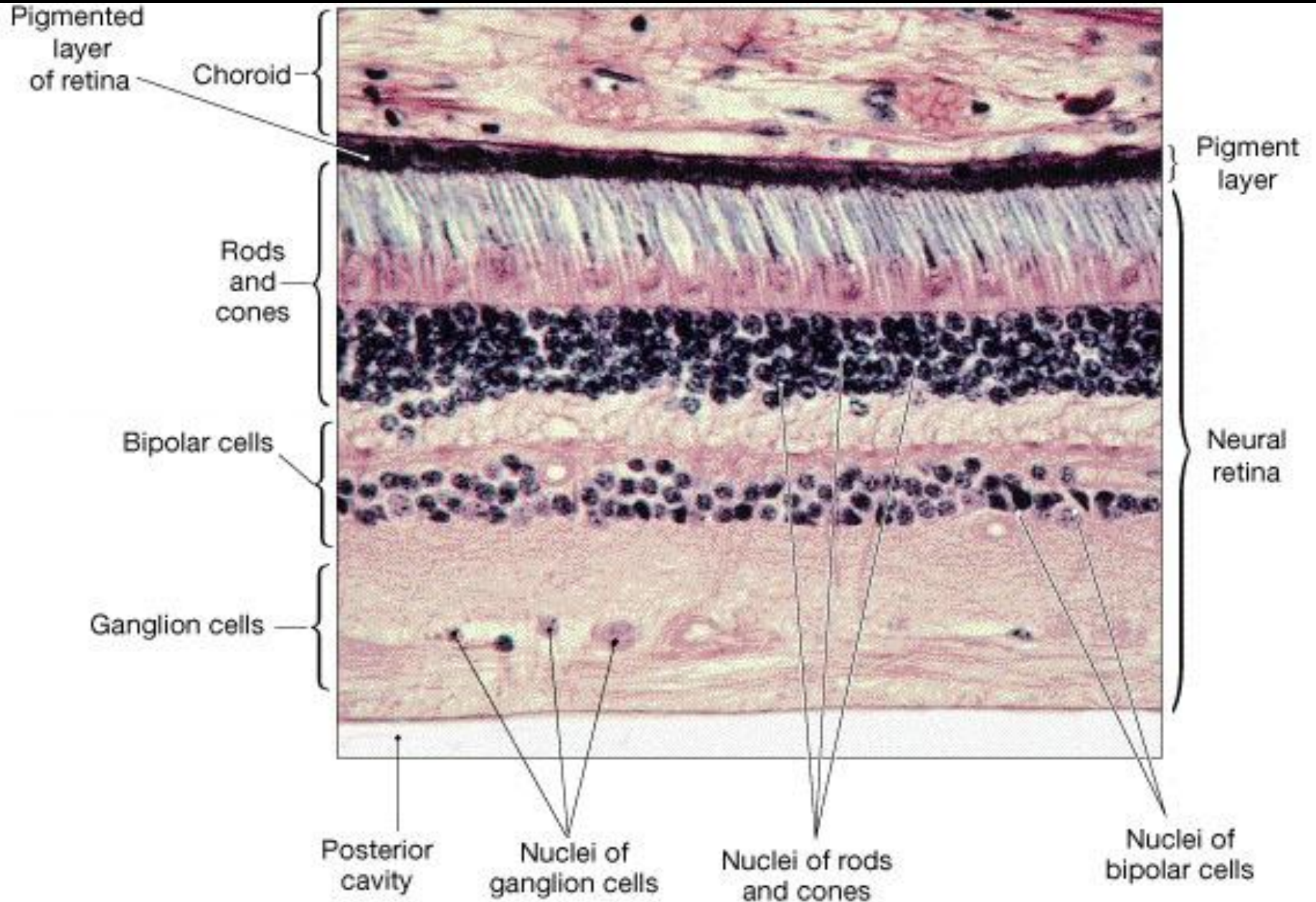
- By Photograph: Danny Hope from Brighton & Hove, UKDiagram: User:Zyxwv99 - Photograph: File:Righ_eye_retina.jpg (which come from My Right Eye)Diagram: Own work (User:Zyxwv99), CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=36685094>

The Retina

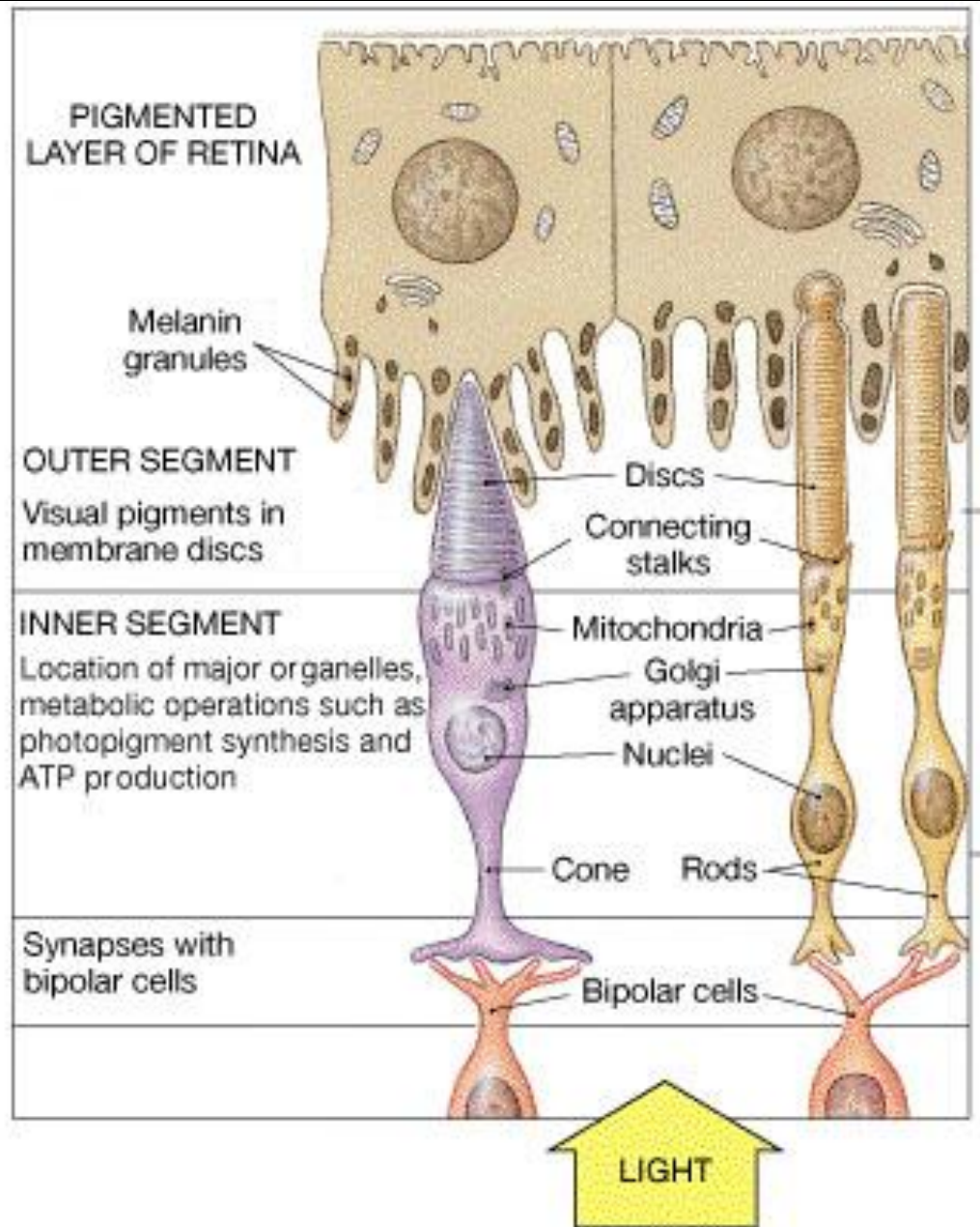
Neural retina typically refers to three layers of neural cells (photo receptor cells, bipolar cells, and ganglion cells) within the retina, while the entire retina refers to these three layers plus a layer of pigmented epithelial cells.



Cellular Organization



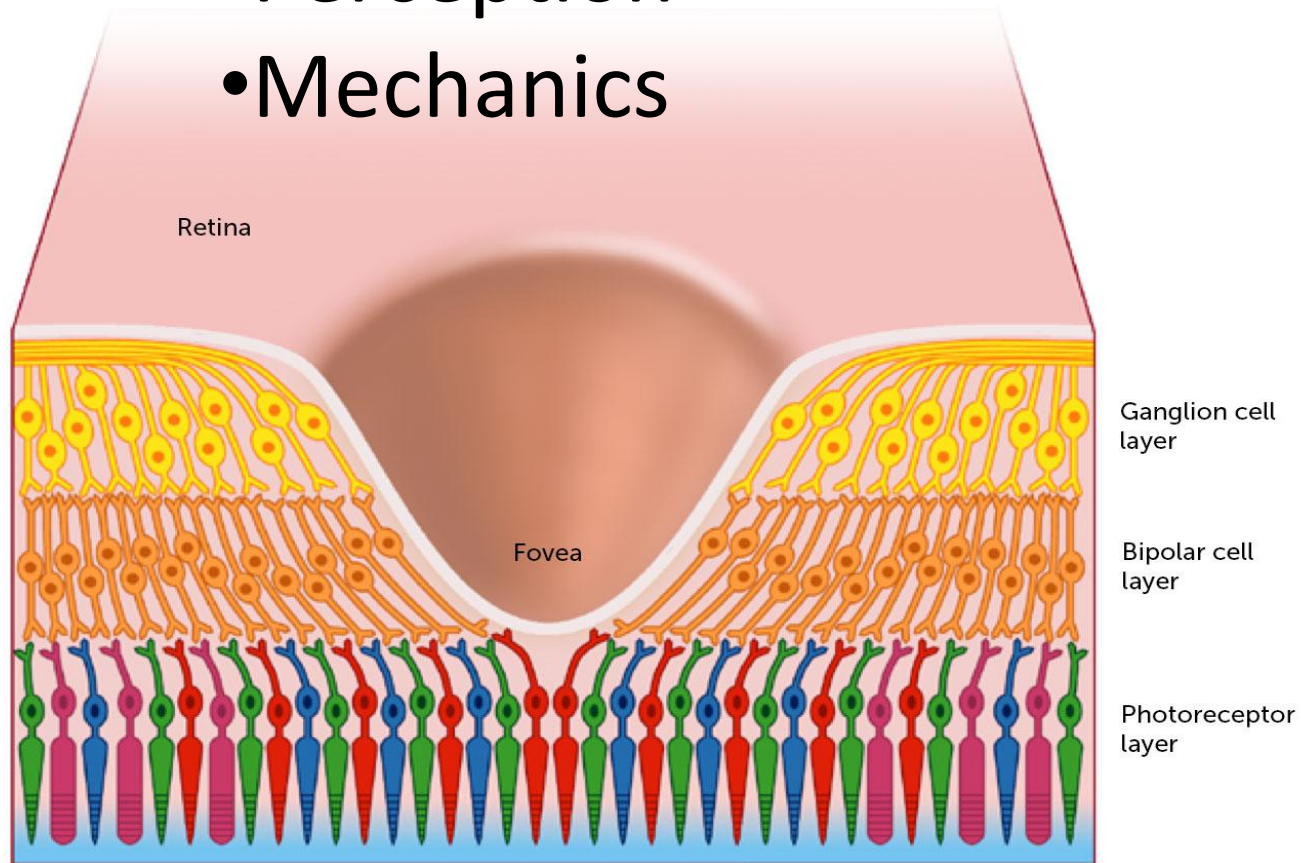
Diagrammatic View of Cells



How we see!

<http://www.brainhq.com/brain-resources/brain-facts-myths/how-vision-works>

- Perception
- Mechanics



Rods located in periphery of retina

Cones located in the center of retina

How we see!

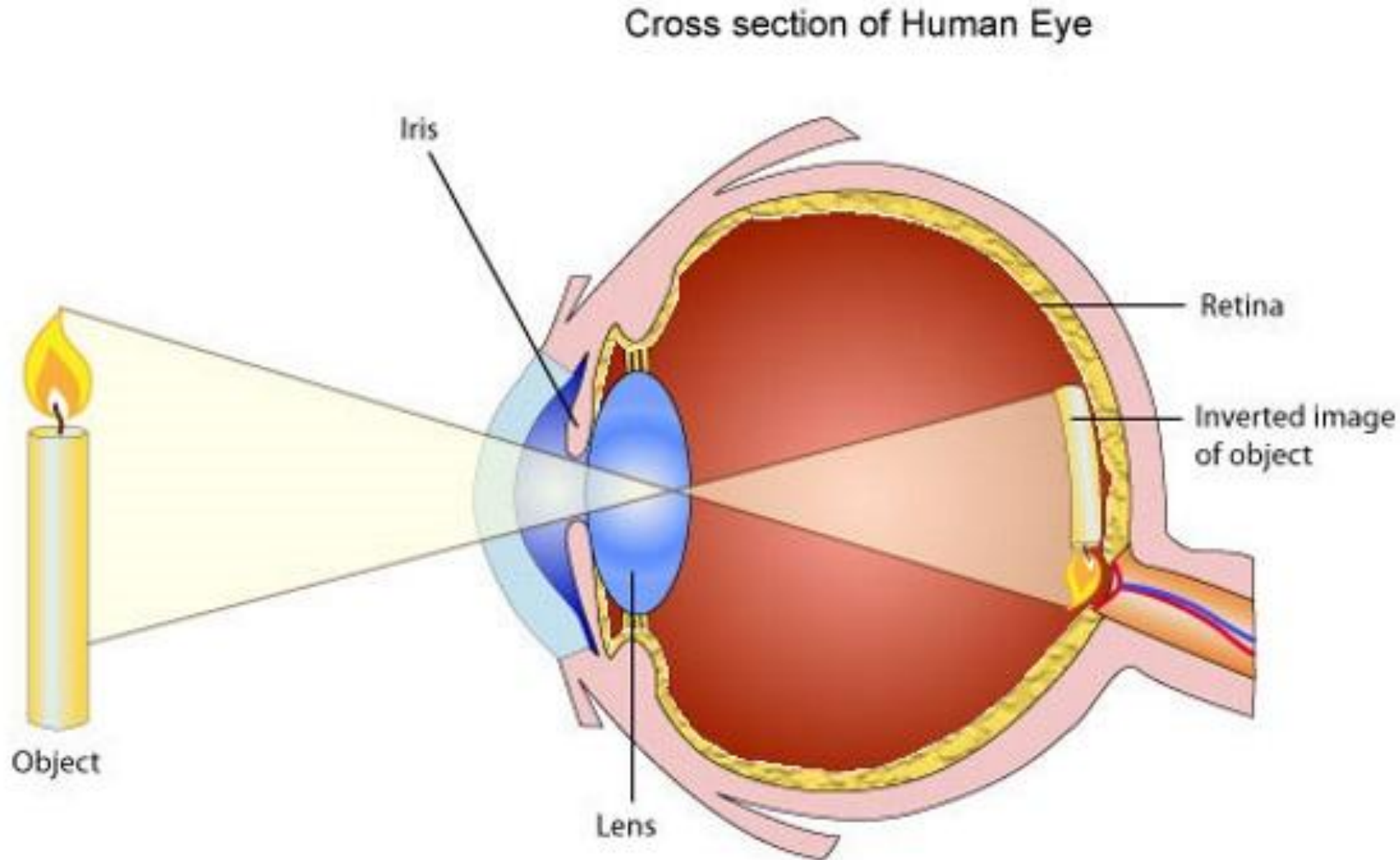
- **Visual perception** begins as soon as the eye focuses light onto the retina, where it is absorbed by a layer of photoreceptor cells. These cells convert light into electrochemical signals, and are divided into two types, **rods and cones**, named for their shape.
- **Rod cells** are responsible for our **night vision**, and respond well to dim light. Rods are found mostly in the peripheral regions of the retina, so most people will find that they can see better at night if they focus their gaze just off to the side of whatever they are observing.

- **Cone cells** are concentrated in a central region of the retina called the fovea; they are responsible for **high acuity tasks like reading, and also for color vision**. Cones can be subcategorized into three types, depending on how they respond to red, green, and blue light. In combination, these three cone types enable us to perceive color.
- Signals from the photoreceptor cells **pass through a network of interneurons** in the second layer of the retina to ganglion cells in the third layer.

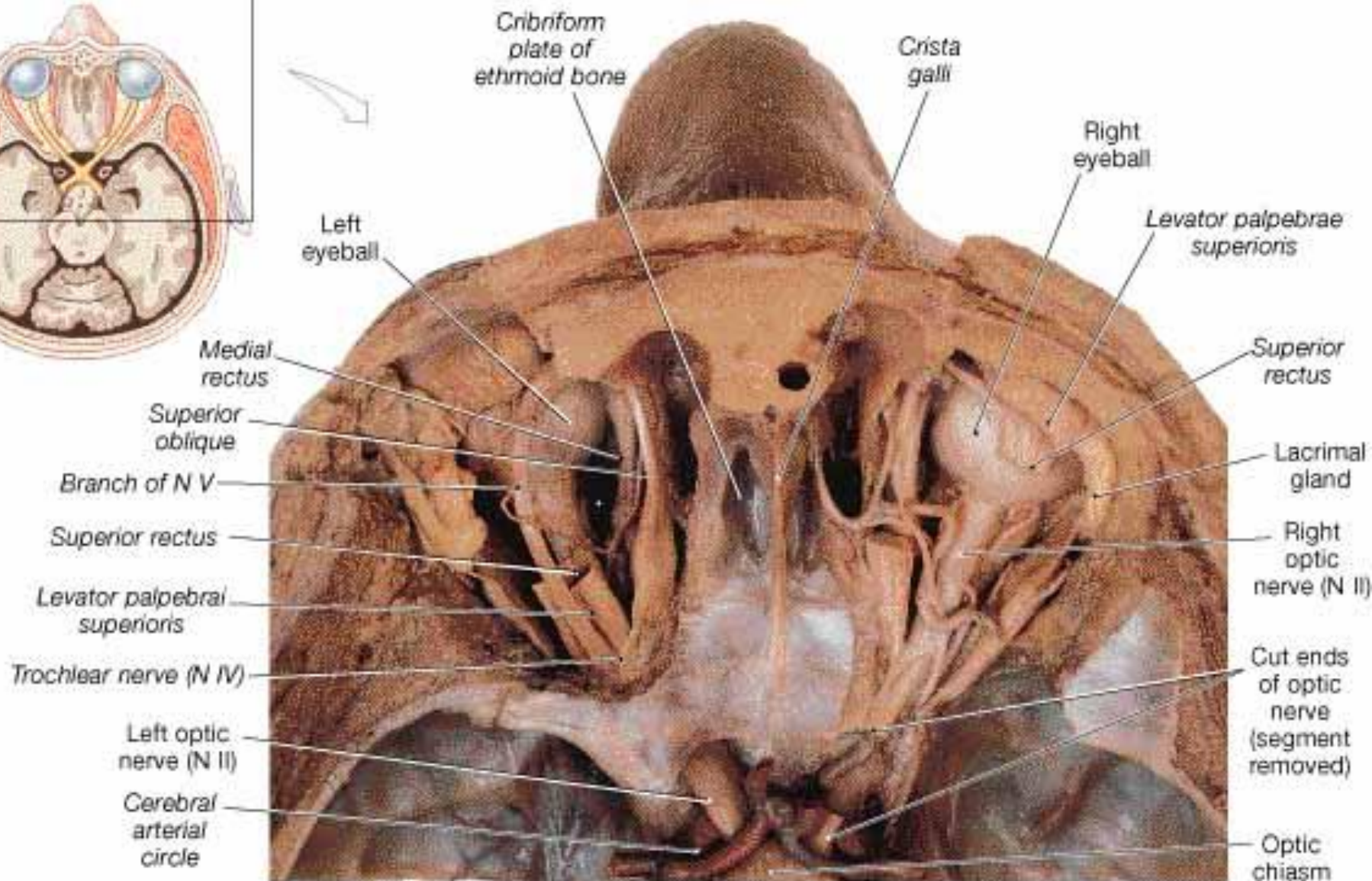
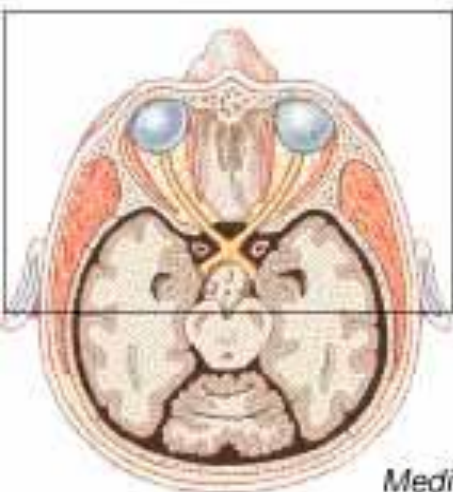
- The neurons in these two retinal layers exhibit **complex receptive fields** that enable them to detect contrast changes within an image; these changes might indicate edges or shadows.
- Ganglion cells gather this information along with other information about color, and **send their output into the brain through the optic nerve**

<https://www.youtube.com/watch?v=kQjiO3tmk0w>

Light is refracted by the lens!

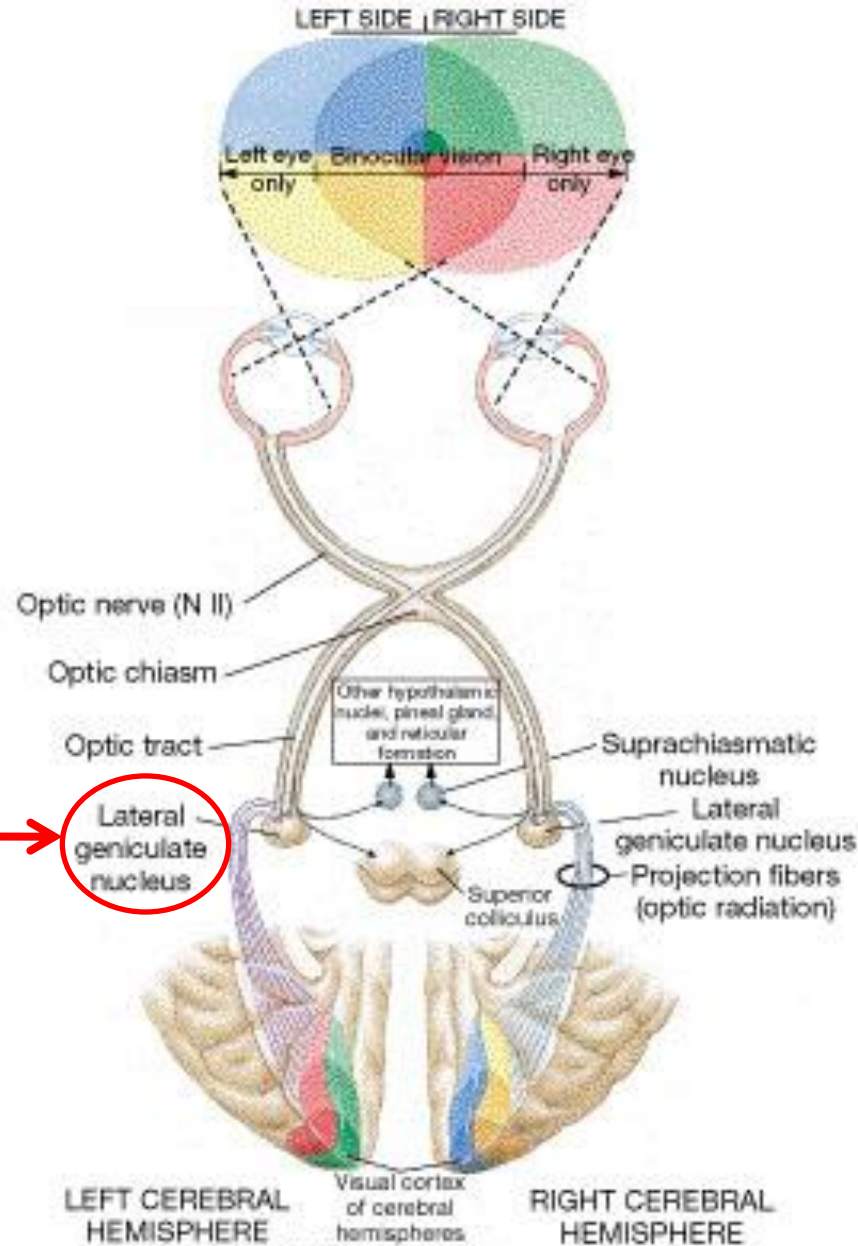


The Optic Nerve



Horizontal section, superior view

Visual Pathways



Part of the thalamus →

For more detail on the retina and how the eyes work

- https://video.search.yahoo.com/yhs/search?fr=yhs-adk-adk_sbnt&hsimp=yhs-adk_sbnt&hspart=adk&p=videos+on+how+the+eyes+work#id=26&vid=63e228ef5630615c1634a2ef613d791e&action=view

A close-up photograph of a woman's face, focusing on her eyes. She has light brown eyes and is looking slightly to the right. The lighting is soft and warm, highlighting the texture of her skin and the details of her eyelashes and eyebrows.

Complications as we grow older

http://www.medicinenet.com/eye_diseases_pictures_slideshow/article.htm

The Eye Exam



Complete Eye Examination

- Vision
- External Exam
- Pupils
- Motility Exam
- Anterior Segment
- Ophthalmoscopy
- Intraocular Pressure
- Peripheral Vision

The Eye Exam!





Which line can you read?

E	1	20/200
F P	2	20/100
T O Z	3	20/70
L P E D	4	20/50
P E C F D	5	20/40
E D F C Z P	6	20/30
FELOPED	7	20/25
DEFFOTEC	8	20/20
LEFODPOT	9	
J D B L T C D O	10	
P E E O L O P P E	11	






Subject Specific Eye Charts

1	20/200	B	blind
2	20/100	BEER	tanked
3	20/70	SUDS	lathered
4	20/50	BREWSKI	dancing fool
5	20/40	COLD ONE	superman
6	20/30	REDNECK WINE	trailer trashol
			
7	20/25	CERVEZA	loco
8	20/20	MAN IN A CAN	tracha
			
9	20/15	LIQUID COURAGE	spirited
10	20/10	ELBOW BENDER	lucy fly
11	20/5	BELL'S BEER	patrol



© 2000 National Eye Institute

1	20/200	W	blotto
2	20/100	WINE	soused
3	20/70	WINO	toasted
4	20/50	WHY NO	lubricated
5	20/40	WINE OH	tipsy
6	20/30	WINE NO	buzzed
			
7	20/25	WHINE OH	ready
8	20/20	WINE KNOW	sober
			
9	20/15	WINE AIN	premeditated
10	20/10	WHY KNOW	collected
11	20/5	WINE KNOW	sober



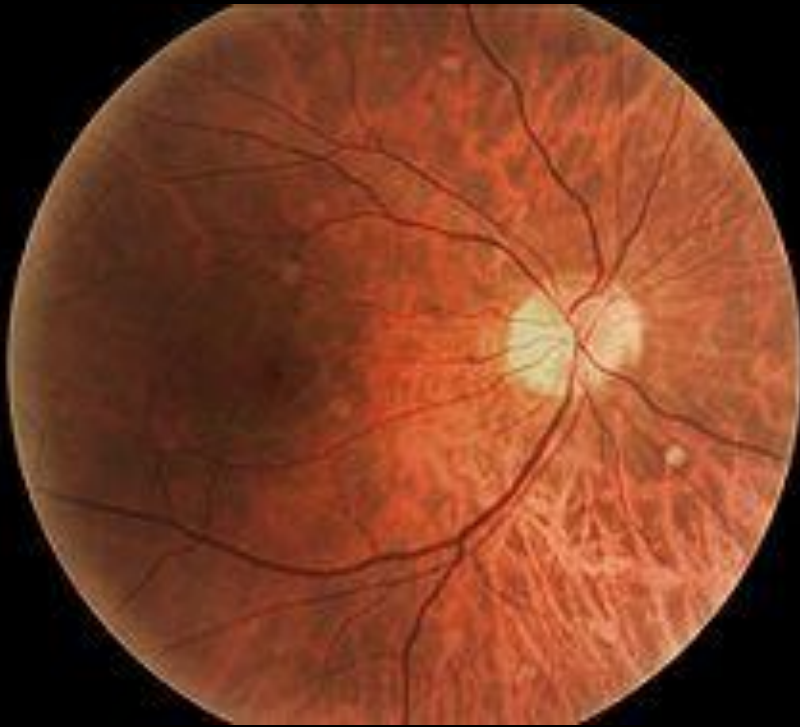
© 2000 National Eye Institute

OCT

By Jcricket1 - Own work, CC BY-SA 4.0,
<https://commons.wikimedia.org/w/index.php?curid=42808605>



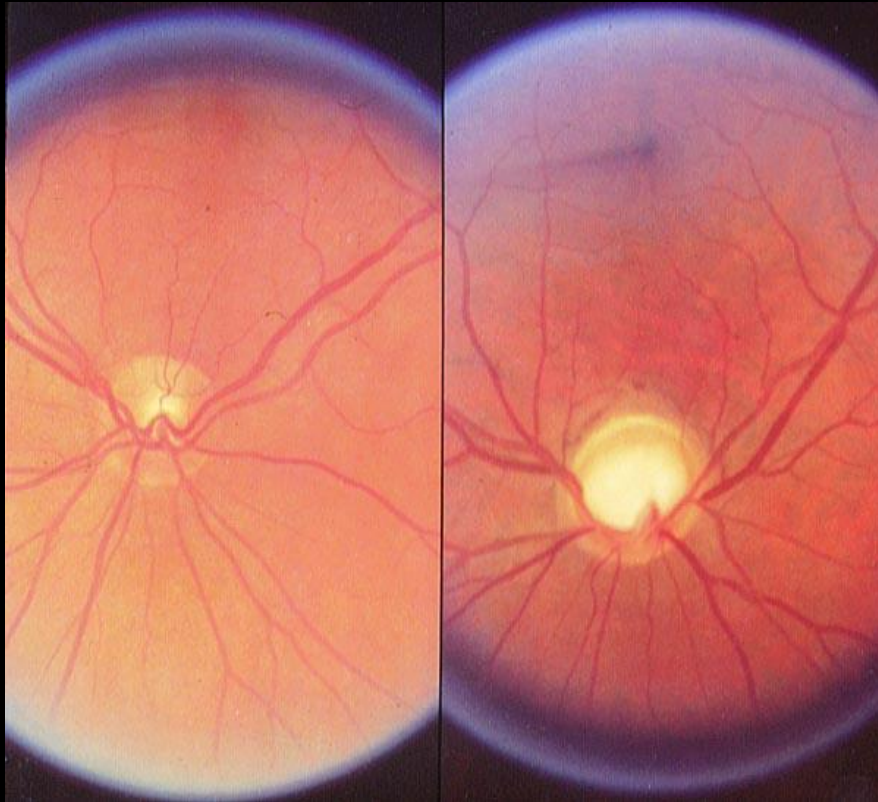
What are you looking for?



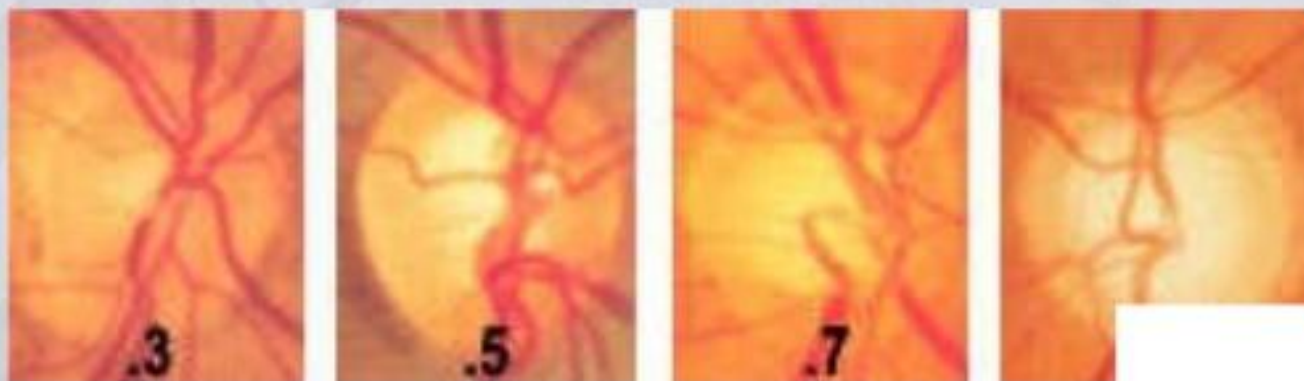
Floaters



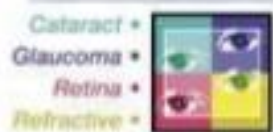
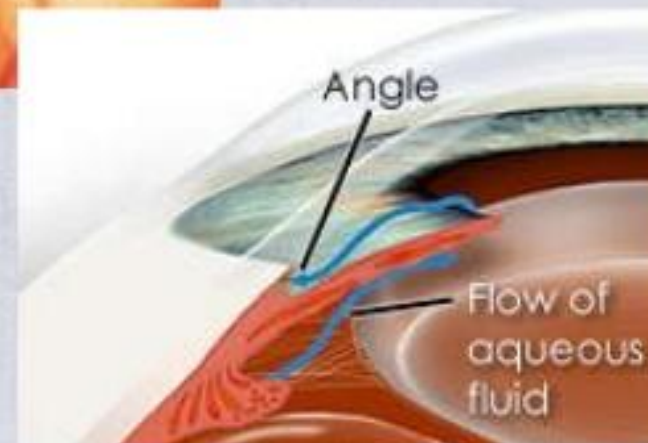
Optic nerve damage in Glaucoma



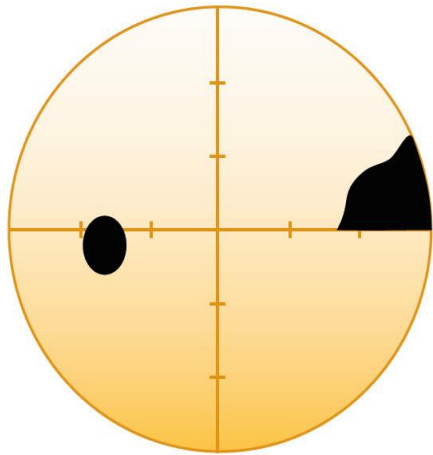
Glaucoma



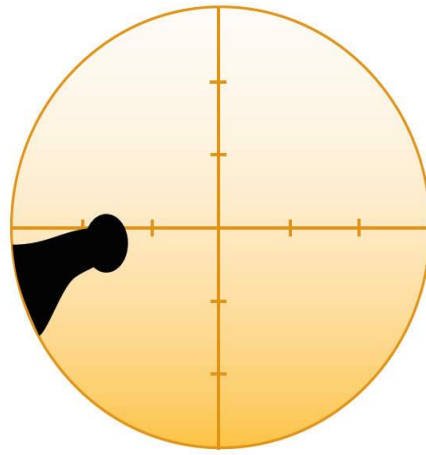
In general, Glaucoma occurs as a result of increased intraocular pressure (IOP) caused by a malformation or malfunction of the eyes drainage system. Normal IOP is 19 – 21 inches of mercury. The increased pressure causes compression of the retina and the optic nerve, and causes **progressive, PERMANENT** loss of eyesight if left untreated.



Glaucoma and the visual fields



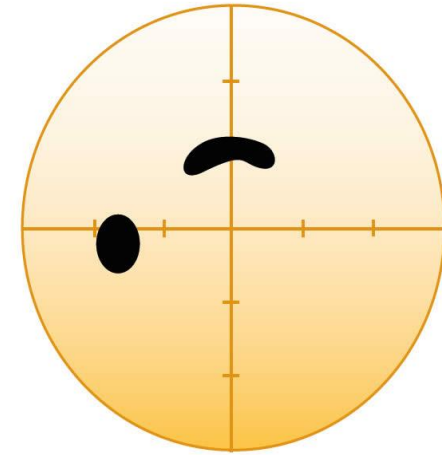
(a) nasal step



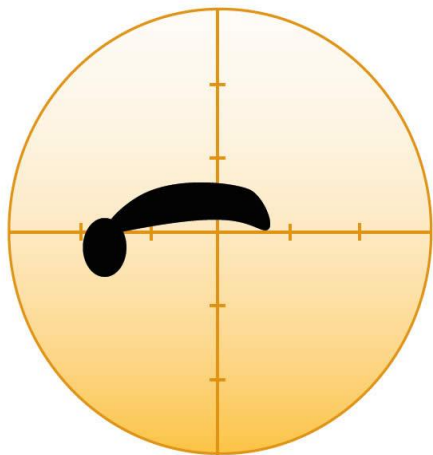
(b) temporal wedge



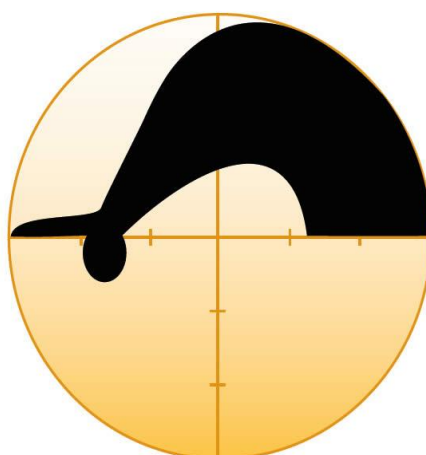
(c) established superior arcuate defect



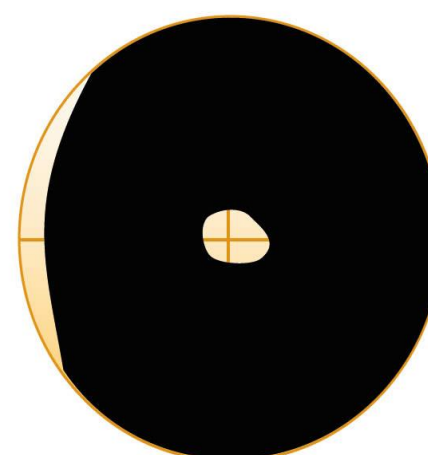
(d) early superior paracentral defect at 10°



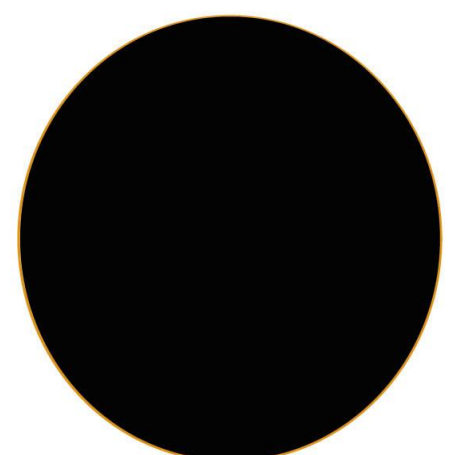
(e) superior, fixation-threatening paracentral defect



(f) superior arcuate with peripheral breakthrough and early inferior defect



(g) tunnel vision defect with temporal crescent sparing



(h) end stage, complete field loss

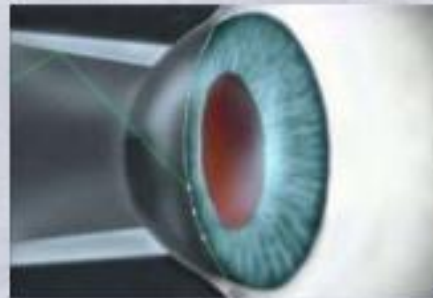
Glaucoma

Treatment

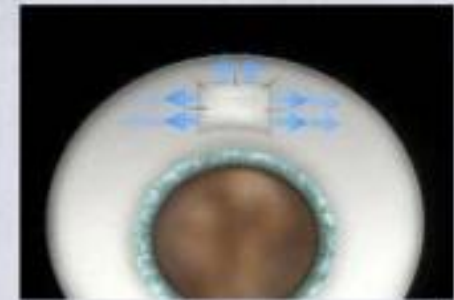
- 👁 Medication
- 👁 Laser Surgery
- 👁 Filtration Surgery



**Medications
are available in
several forms.**





**Laser surgery
can reduce the
need for
medications**



**Filtration
Surgery
creates a new
drainage
channel**

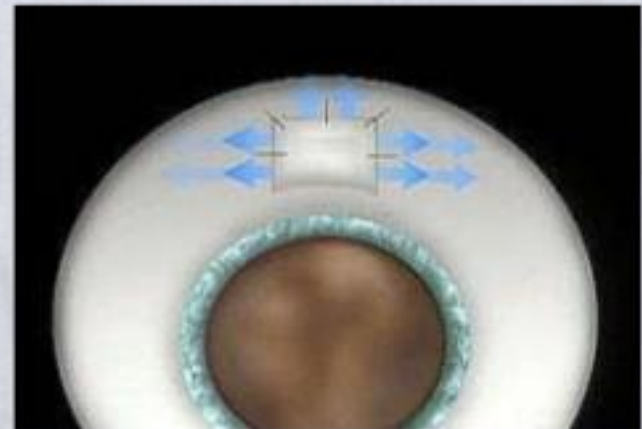
Glaucoma

Treatment

-  Laser Iridotomy
-  Filtration Surgery



In Laser Iridotomy, a small hole is cut in the Iris

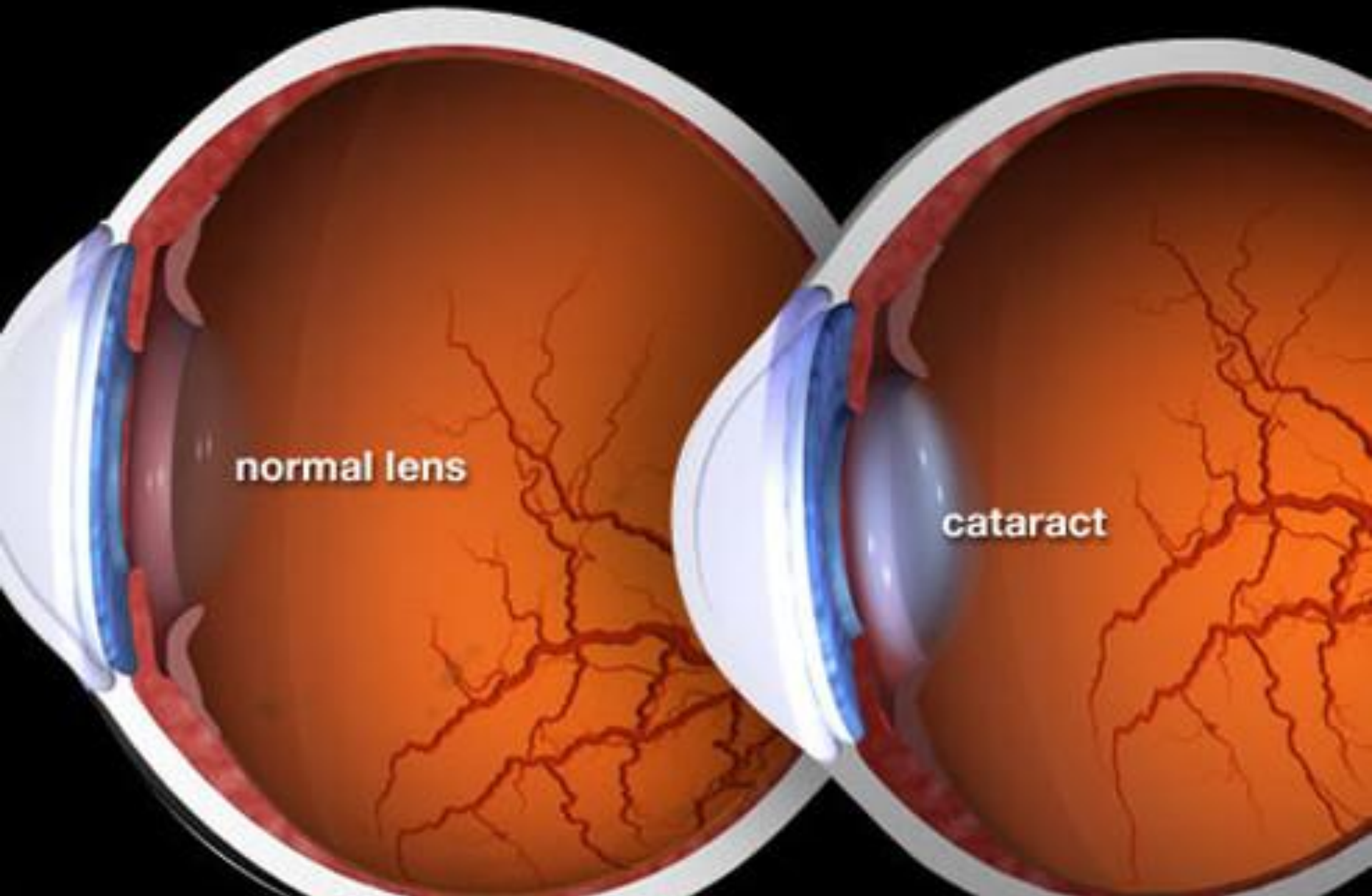


Filtration Surgery creates a new drainage channel

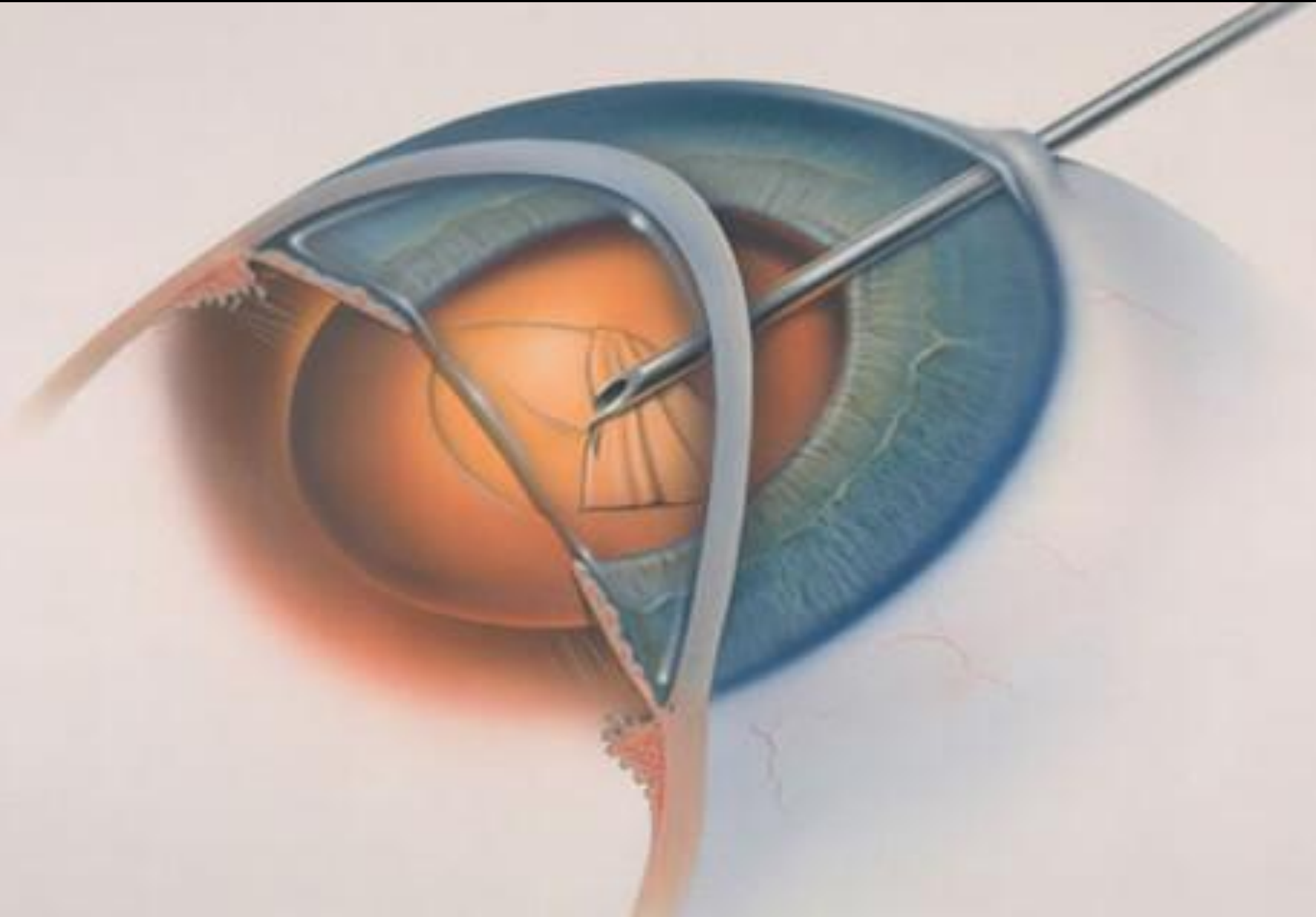
Cataracts



How to Treat Cataracts



Cataract Surgery



Age-related Macula Degeneration (AMD)



<http://www.slideshare.net/hmirzaeee/agerelated-macular-degeneration>

Age-Related Macular Degeneration (AMD)

A common, chronic, progressive, degenerative disorder of the macula that affects older individuals and features central visual loss as a result of drusen deposition, geographic atrophy, detachment of the retinal pigment epithelium, and neovascularization.

Soft Drusen



Atrophy



Exudation



Very advanced scarring



Risk Factors for AMD

Not Modifiable

- Genetic disease with inflammation playing a role
 - Dysregulation of complement pathway leading to aberrant inflammatory response
- Women > men
- Caucasians > blacks
- Light iris colour > dark iris colour

Modifiable

- Risk factors for cardiovascular disease
- Oxidative damage due to cardiovascular disease
- Hypertension and smoking
- Inflammation
- Diet
- Phototoxicity

Treatment

- Traditional Laser
- Photodynamic therapy (PDT)
- Drugs to prevent growth of blood vessels
(Anti VegF)
(Avastin, Lucentis , Macugen)
- Combination Therapy

New Possibilities I

- Emixustat (pill for dry AMD from Acucela)
- Gene Therapy
- Transplants of Retinal Tissue
- VegF-TRAP (Eyelea)

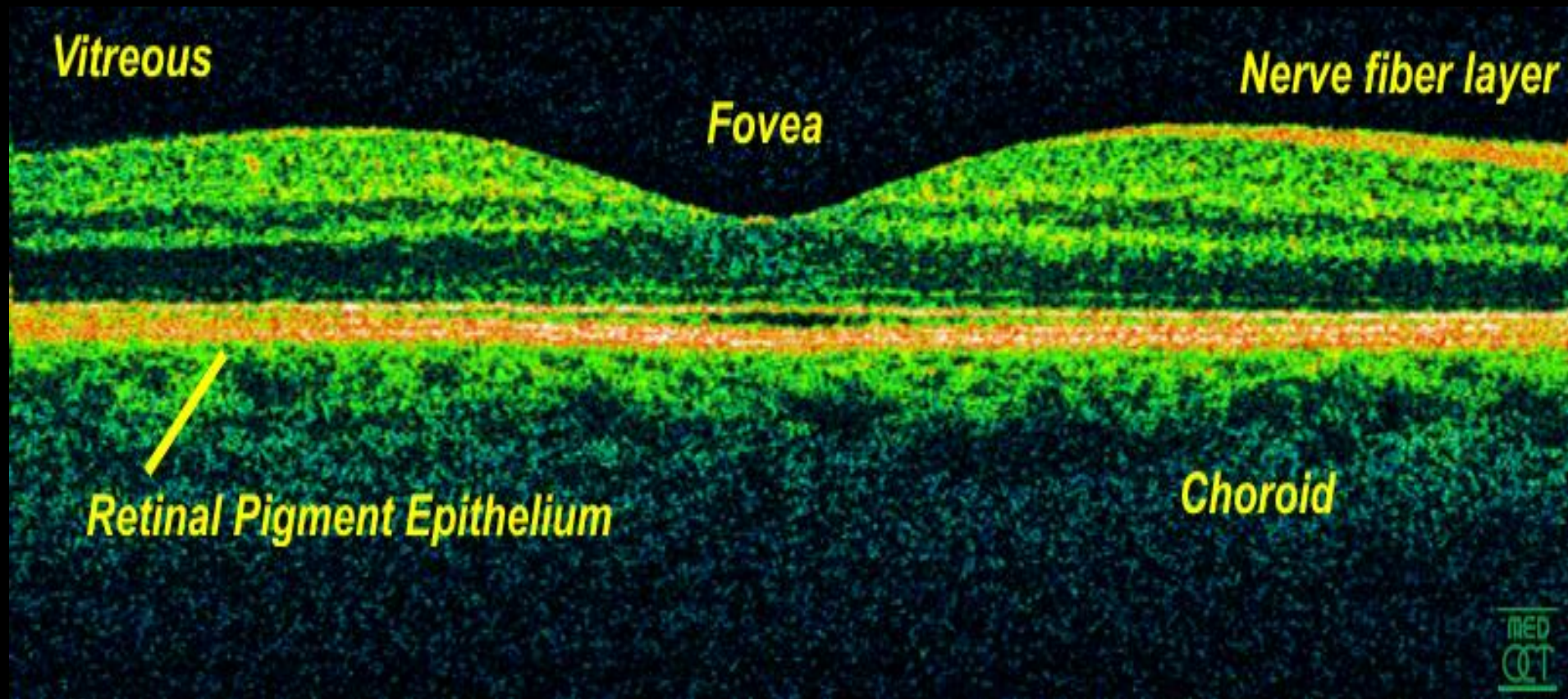
New Possibilities II

- I Ray (radiotherapy from Oraya)
- AAQ (chemical to make other retinal cells work like photoreceptors)
- Photo Voltaic cells
- Stem cells
- Anti-VegF given by eyedrop

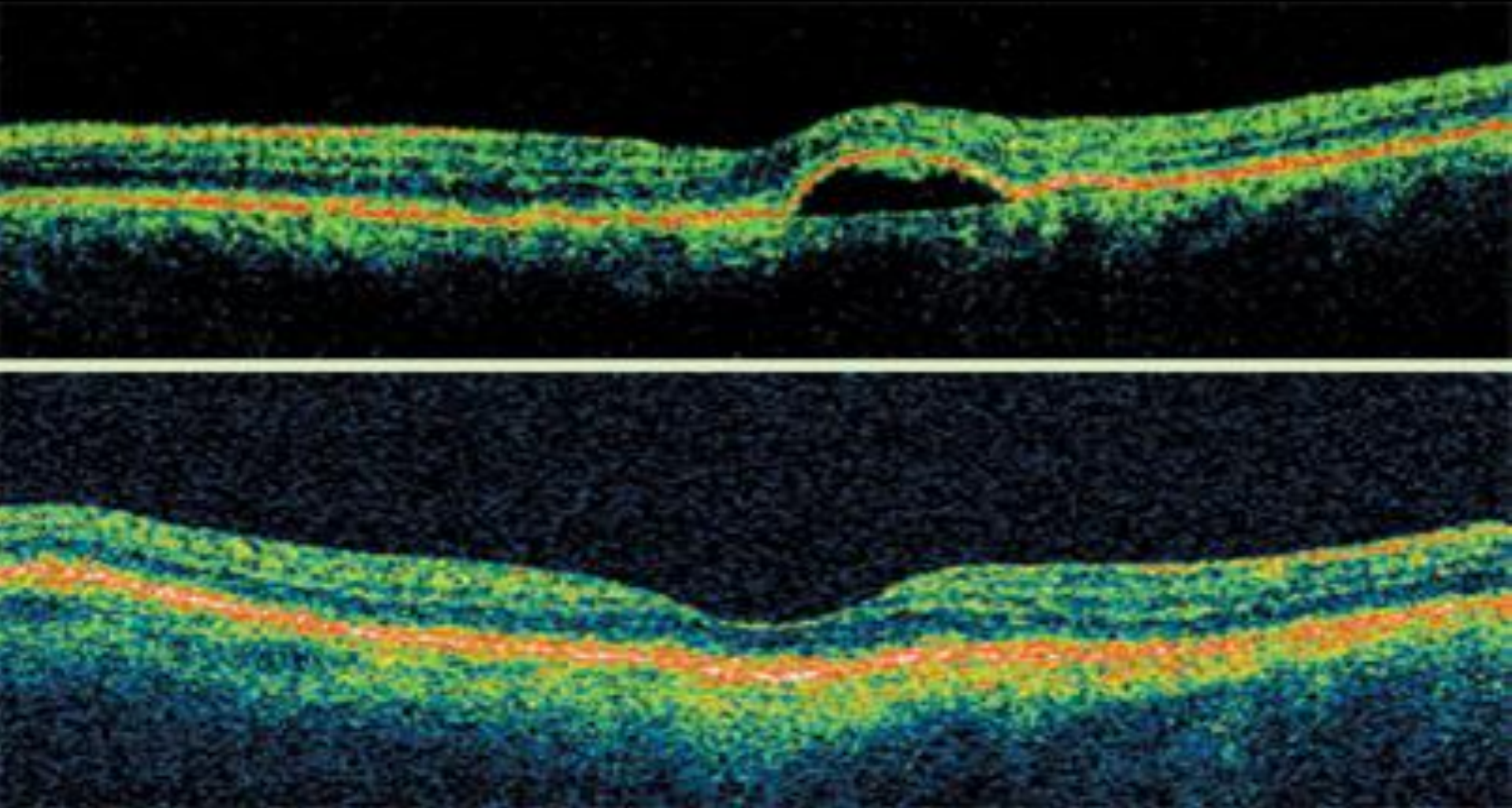
Intravitreal Injection



OCT of Healthy Macula



OCT showing fluid



Lutein?

Year 1



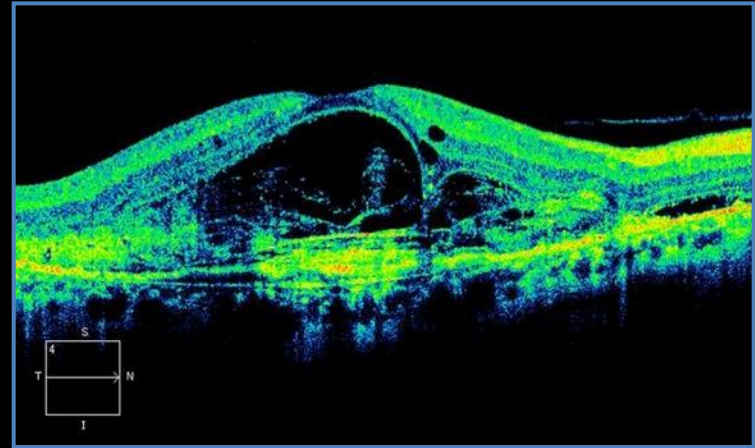
Year 2



Case Study: Marie

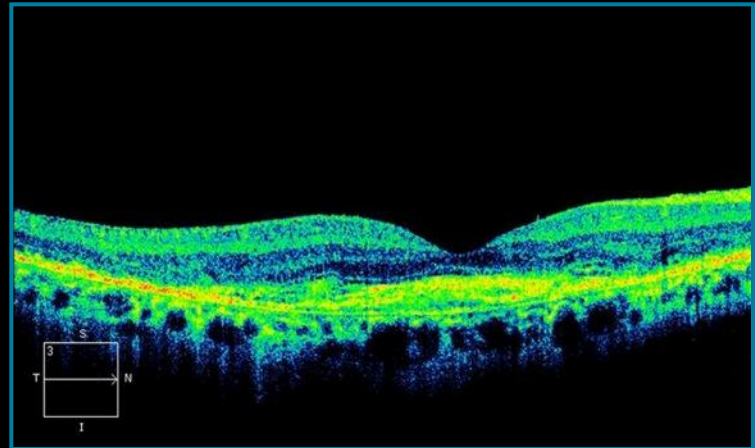
Pre-treatment:

Retinal thickness 305 μm , VA 20/80



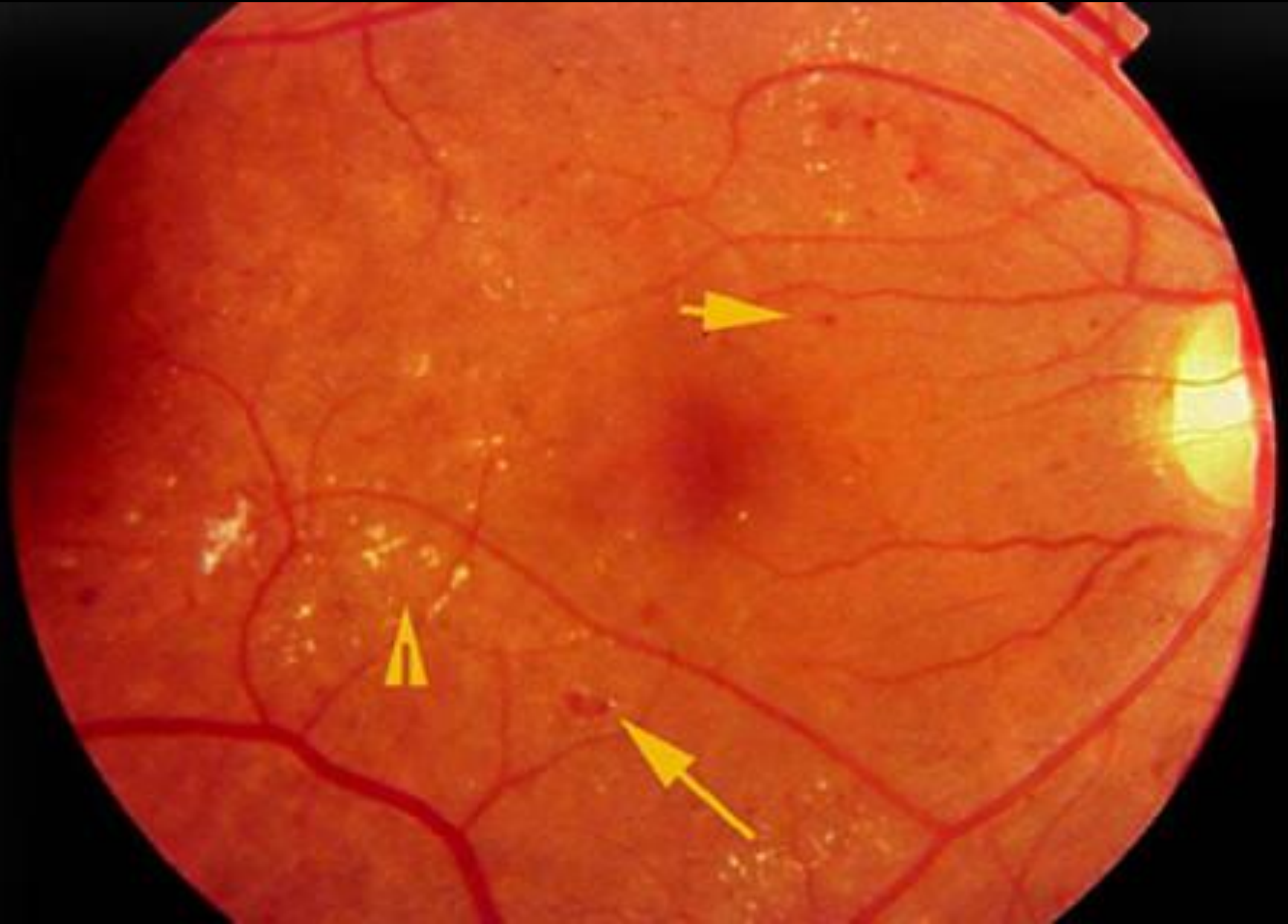
Post-ranibizumab treatment:

Retinal thickness Month 6 - 172 μm , VA 20/40



What changes can you identify from the OCT images
From before and after treatment?

Diabetic Retinopathy

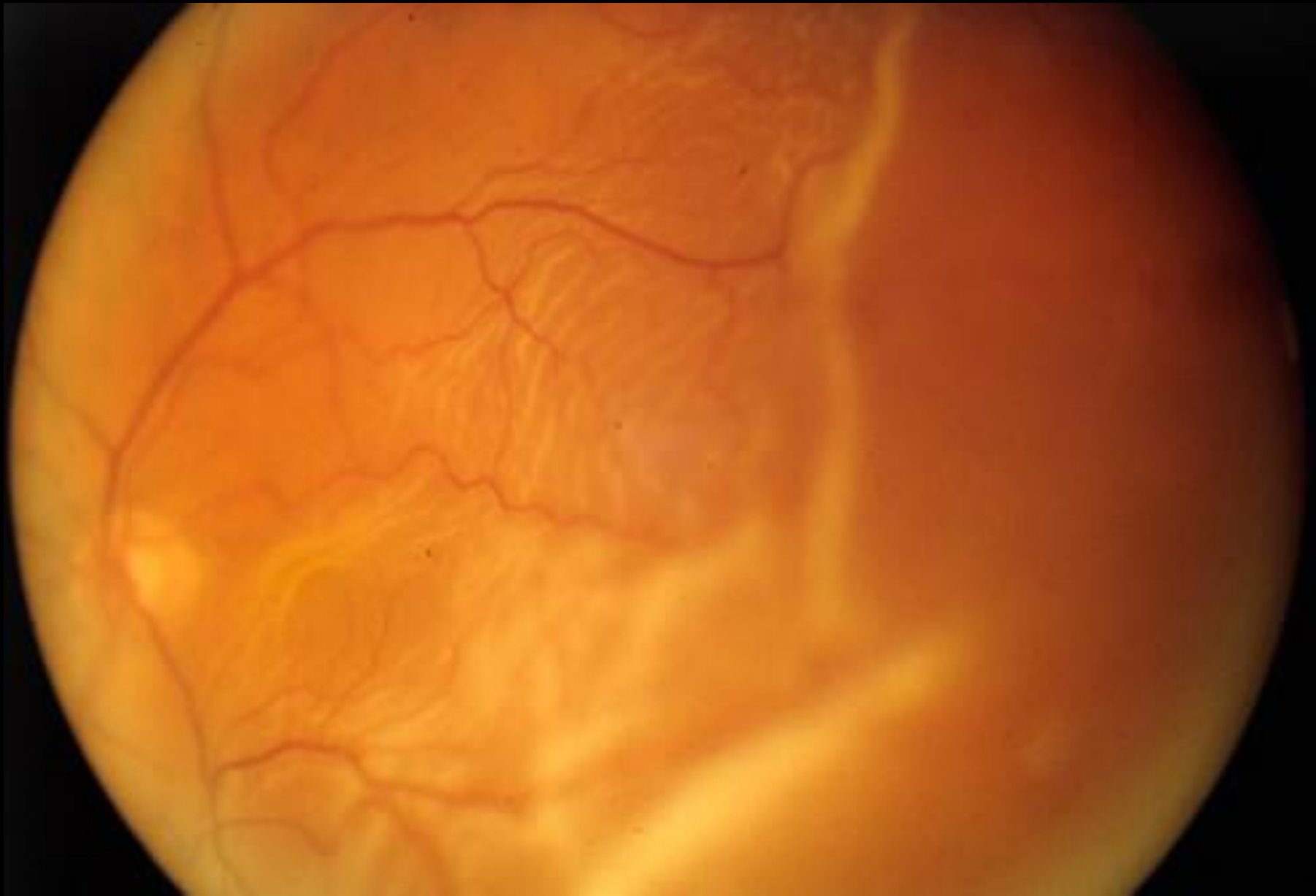


Treatment

- There is no cure for diabetic retinopathy.
- But **laser treatment (photocoagulation)** is usually very effective at preventing vision loss if it is done before the retina has been severely damaged.
- Surgical removal of the vitreous gel (**vitrectomy**) may also help improve vision if the retina has not been severely damaged.



Detached Retina

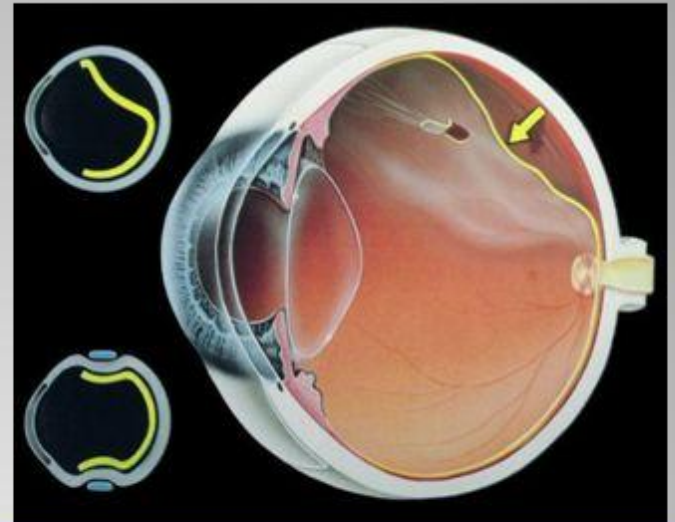


RETINAL DETACHMENT

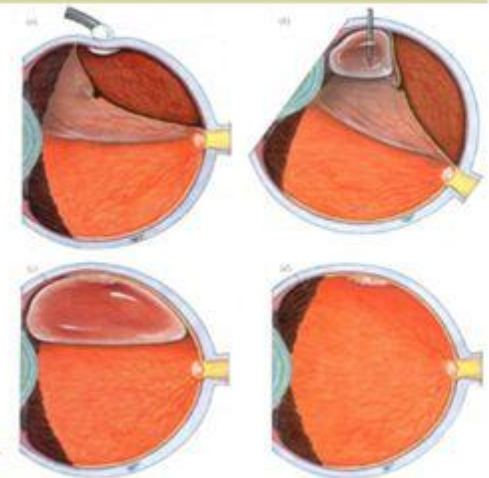
- Separation of neuro-sensory retina from pigmented epithelium is called retinal detachment

Types

- Primary or simple or Rhegmatogenous: separation of retina in the form of hole or tear. This hole allows the vitreous to raise retina from its normal position
- Secondary or exudative : due to pathology and the accumulation of fluid to push retina from its normal position
- Tractional : due to fibrovascular proliferation as in proliferative diabetic retinopathy or trauma
- Treatment-Laser treatment
Retinopexy use to reattach the detached retina.

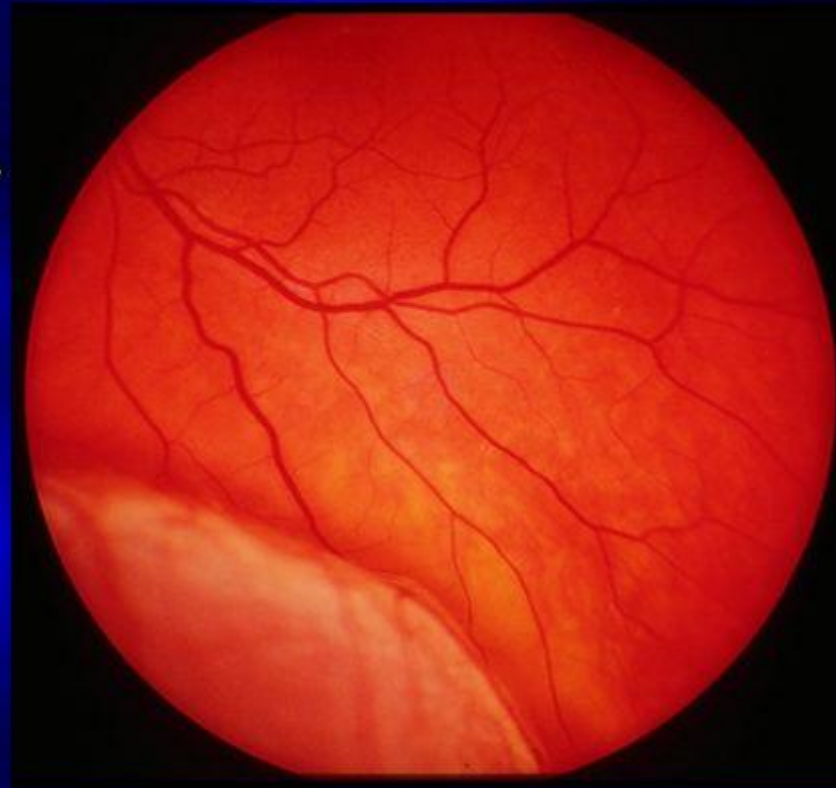


Pneumatic retinopexy



Retinal Detachment

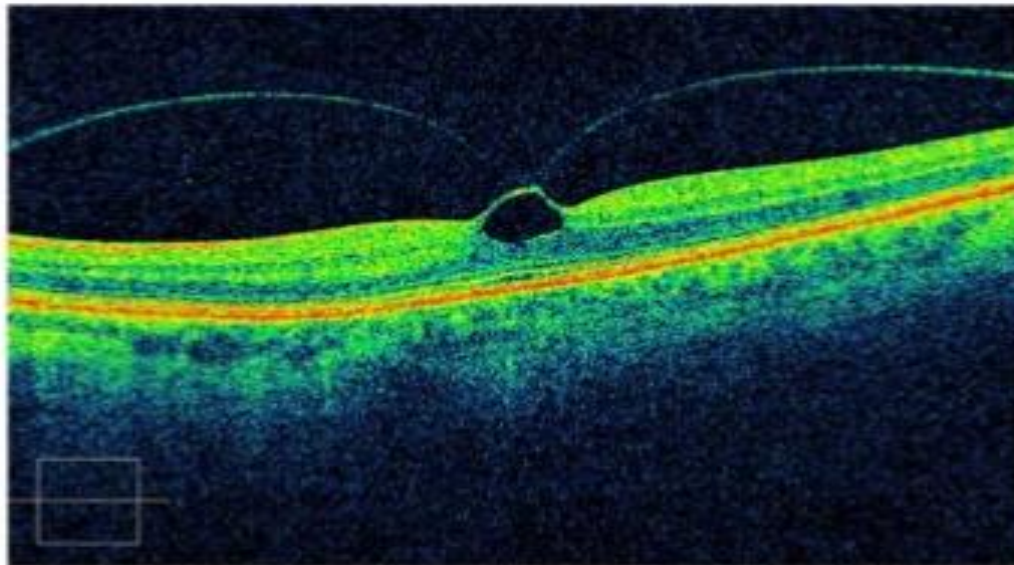
- Treatment
 - Consult ophthalmology **immediately** any time of night esp. if “mac on”
 - Prevent worsening RD
 - Bed rest, supine if superior RD
 - Protect eye from trauma (eg. metal eye shield)



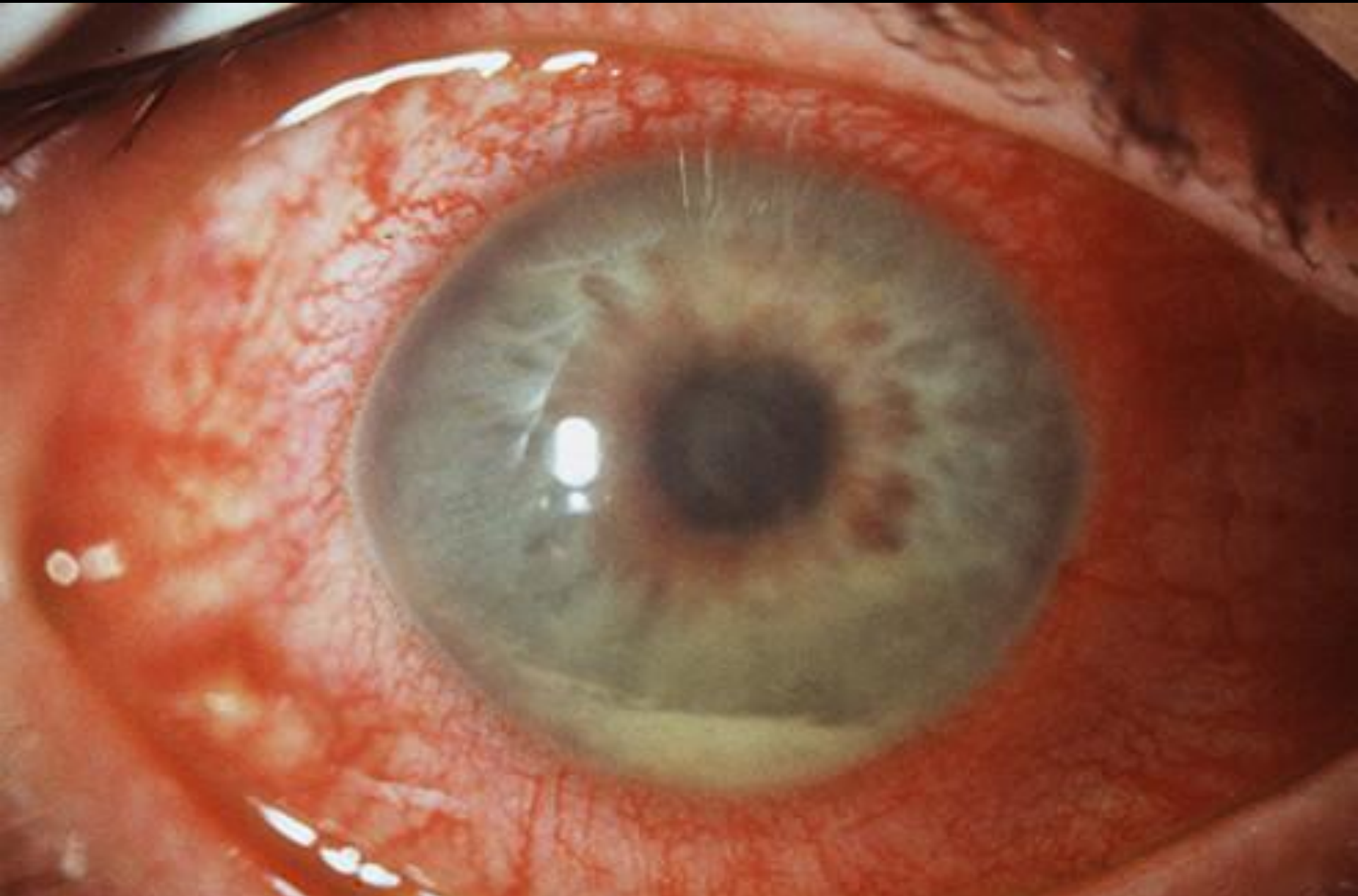
Macular pucker/hole

New chemical treatment (Jetrea)

VITREOMACULAR TRACTION



Uveitis



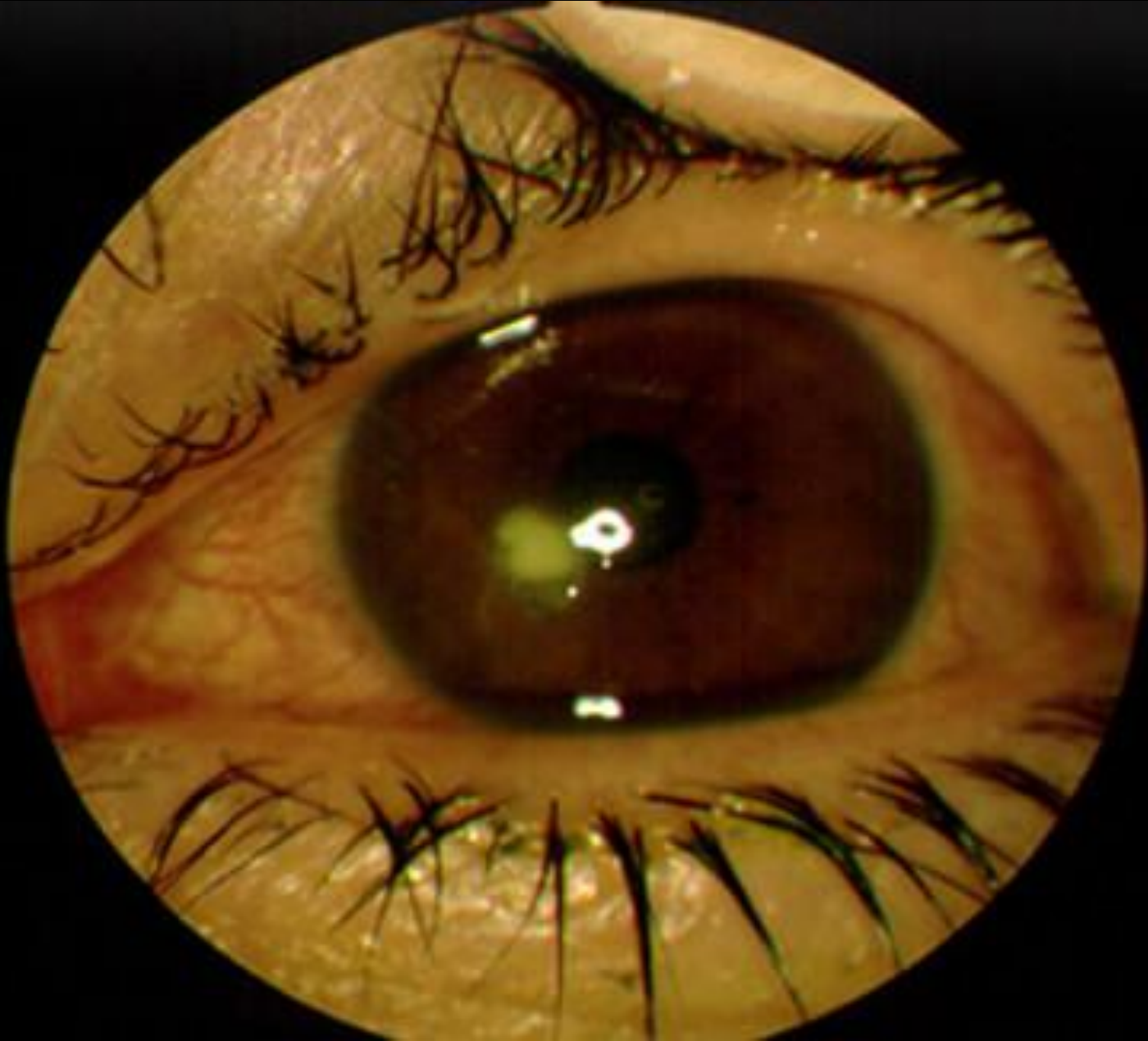
Anti-inflammatory agents



- '-itis' = inflammation
- Treatment : stop inflammation
- Use anti-inflammatory drugs
- Most potent of such agents : Corticosteroids
- *Corticosteroids are the mainstay of therapy in uveitis*

Dr. A. Karanth (www.ophtalclass.blogspot.com)

Corneal Ulcer



Corneal ulcers

- Discontinuation in normal epithelial surface of cornea associated with necrosis of the surrounding corneal tissue
- It can be:
- **Bacterial corneal ulcer**
- **Fungal corneal ulcers**
- **Viral corneal ulcers**
- **Protozoal corneal ulcers**

Strabismus (Crossed Eyes)



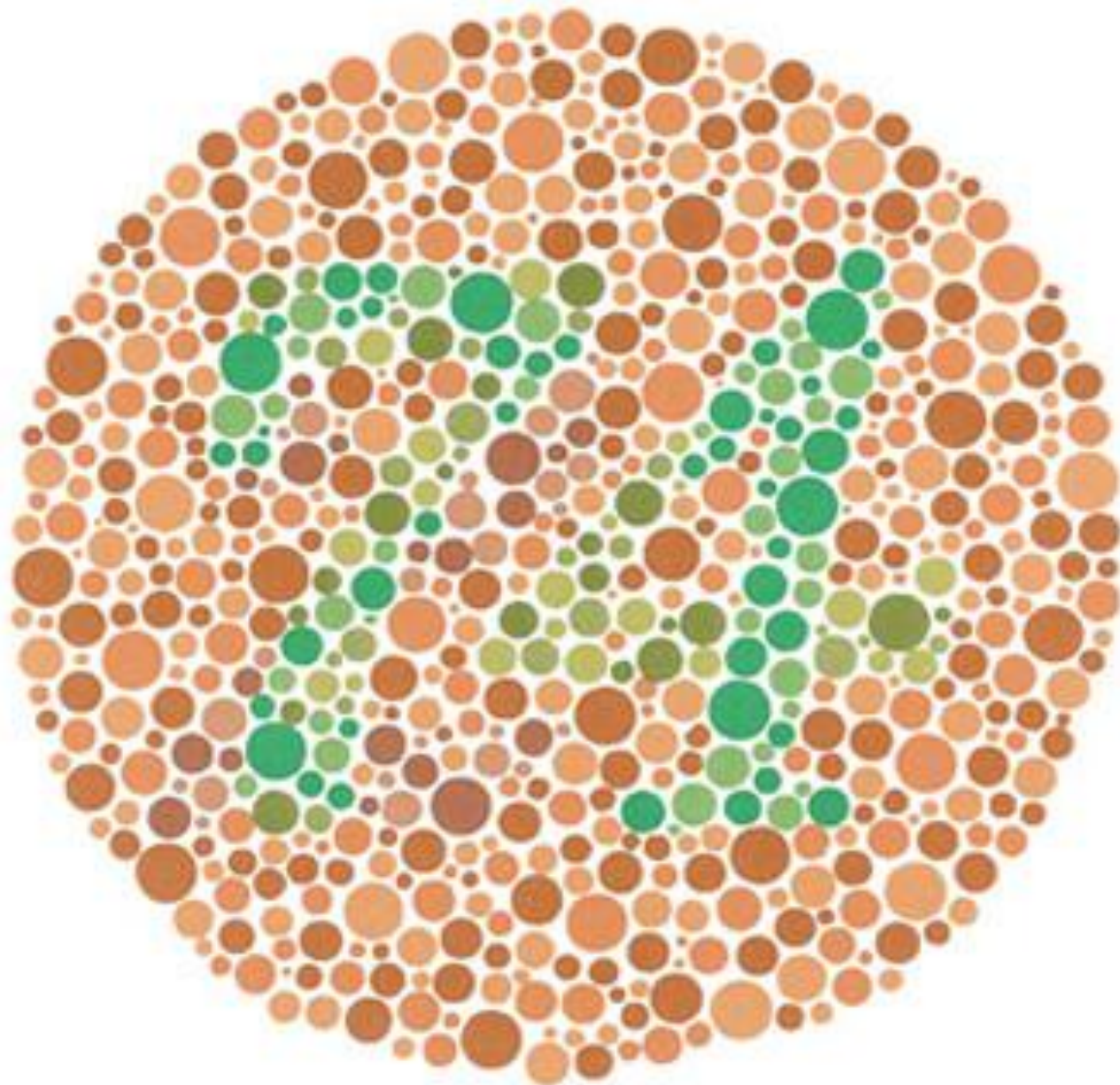
Eye Allergies



Conjunctivitis



Colour blindness

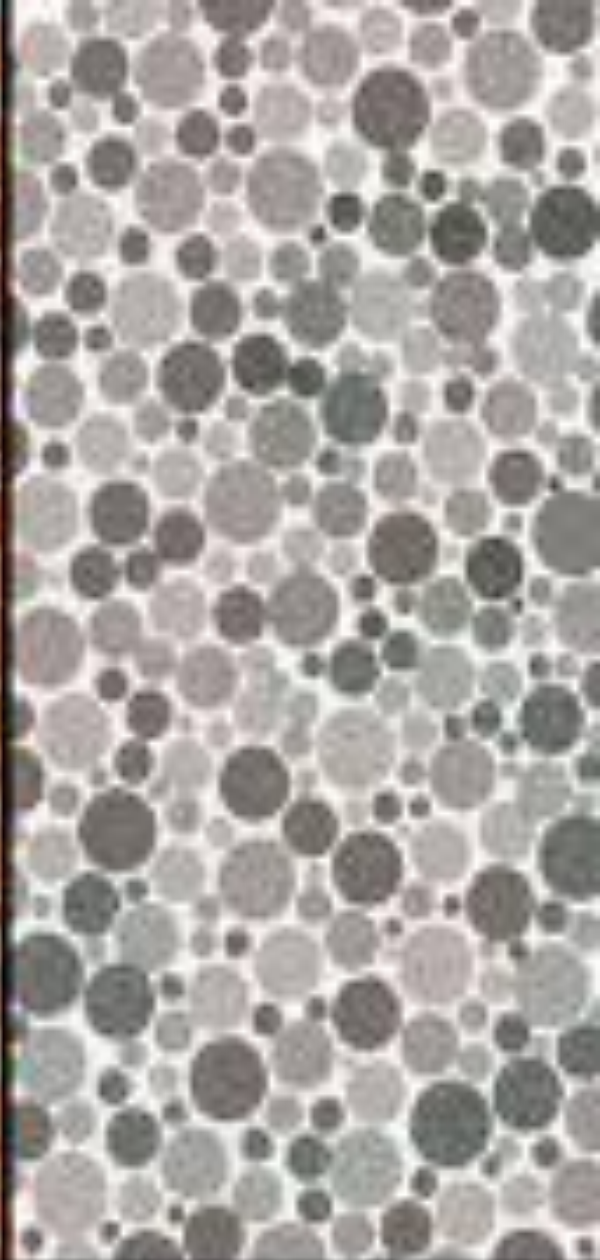




Normal



Partially Colorblind
(simulation)



Colorblind
(simulation)

Astigmatism



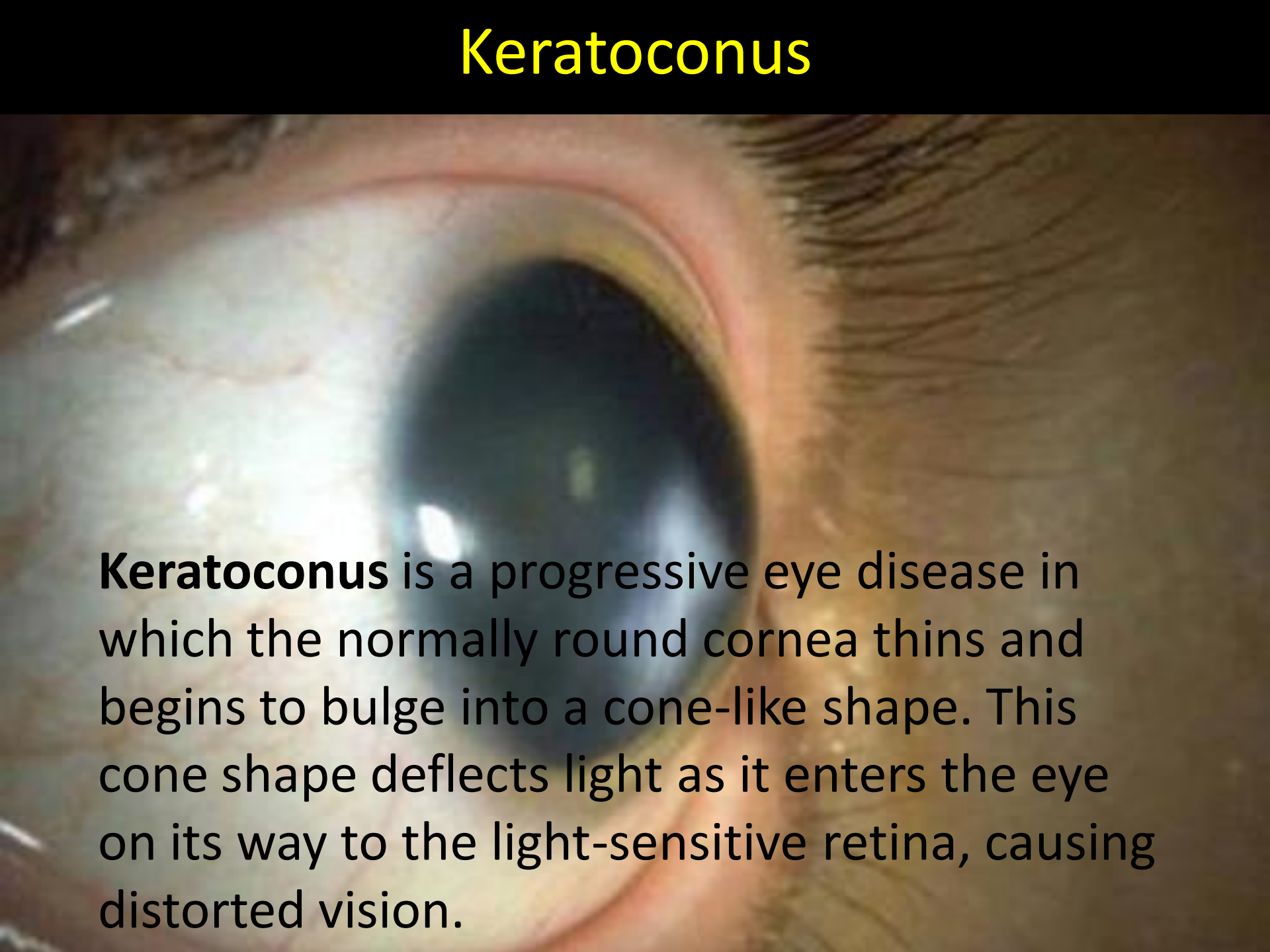
Visual problems

- Far sightedness
- Short sightedness

<https://www.youtube.com/watch?v=YcedXDN6a>

88

Keratoconus



Keratoconus is a progressive eye disease in which the normally round cornea thins and begins to bulge into a cone-like shape. This cone shape deflects light as it enters the eye on its way to the light-sensitive retina, causing distorted vision.

Management



1. Glasses
2. Contact lenses
3. Collagen cross linking
4. Intracorneal rings
5. LASIK Xtra
6. Deep anterior lamellar Keratoplasty
7. Penetrating Keratoplasty

From: Dr. Y.S. Rathore

Night Vision



Nice tapetum Lucidum

The aging cornea and lens in the eye become less clear as we age, causing light to scatter inside the eye, which increases glare. ... Our ability to resist glare and see reflective road signs and markings also decreases with age.

Take home message

- Pain is not a good indicator of the severity of the problem.
- Painless loss of vision-**seek help immediately**
- Answer is to have regular check ups with your eye doctor





Questions?

UVRA Elder Academy: Upcoming series

- **Mini Med School**

- January 14th, 21st, 28th, February 1st, 8th and 15th
- Presenters: Sergiy Shatenko and Samuel Harder

- **The German Lied Series**

- March 4th, 11th, 25th (Saturday) and April 2nd (Sunday)
- Presenters: Harald (pianist) and Sharon Krebs (soprano)

In the planning (April-July)

- Native plant series
- Astronomy series
- Nutrition series
- The chemistry of wine making
- Visit to labs in Exercise Science.

Healthy Retina

Retinal pigment epithelium (RPE)

- Supplies photoreceptor with nutrients (white arrows)
- Pumps out waste out (blue arrows)

