Retinal Diseases

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U.C. Davis Eye Center

Financial Disclosures

Overview

- Background Information
- Retinal Vascular Disease
- Age-Related Macular Degeneration
- Diabetic Retinopathy
- Questions from the Audience

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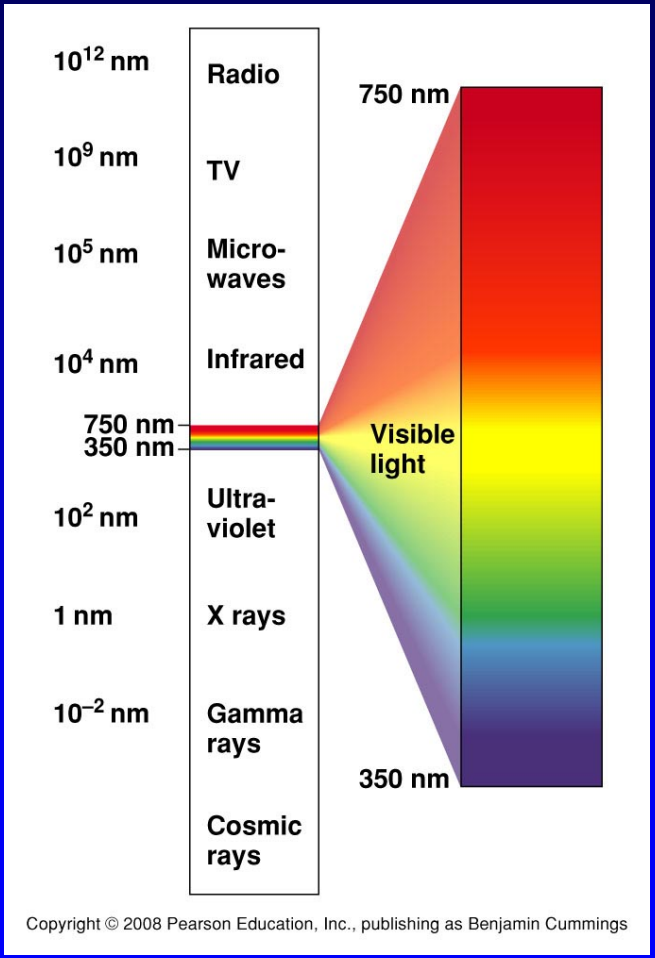
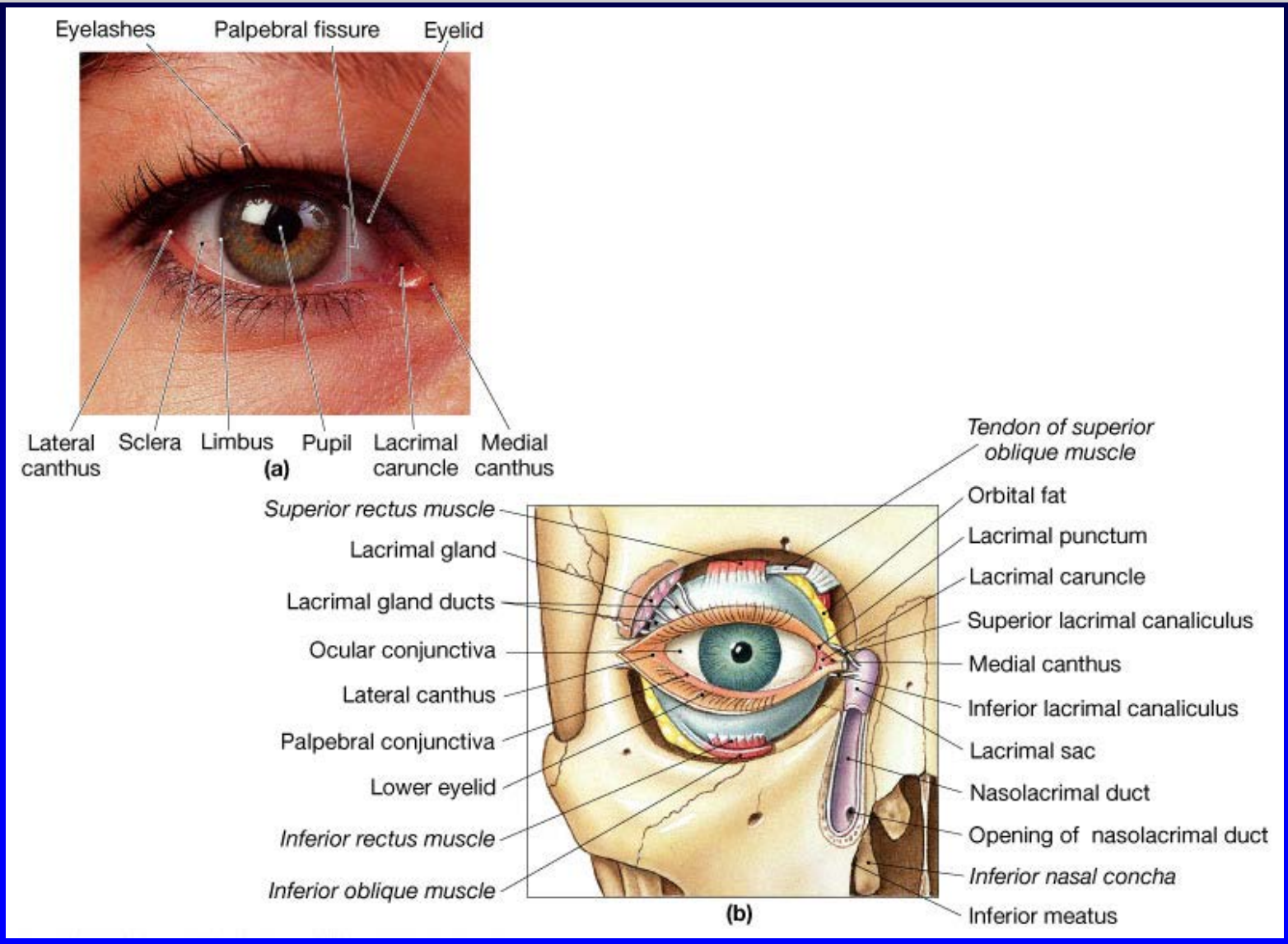
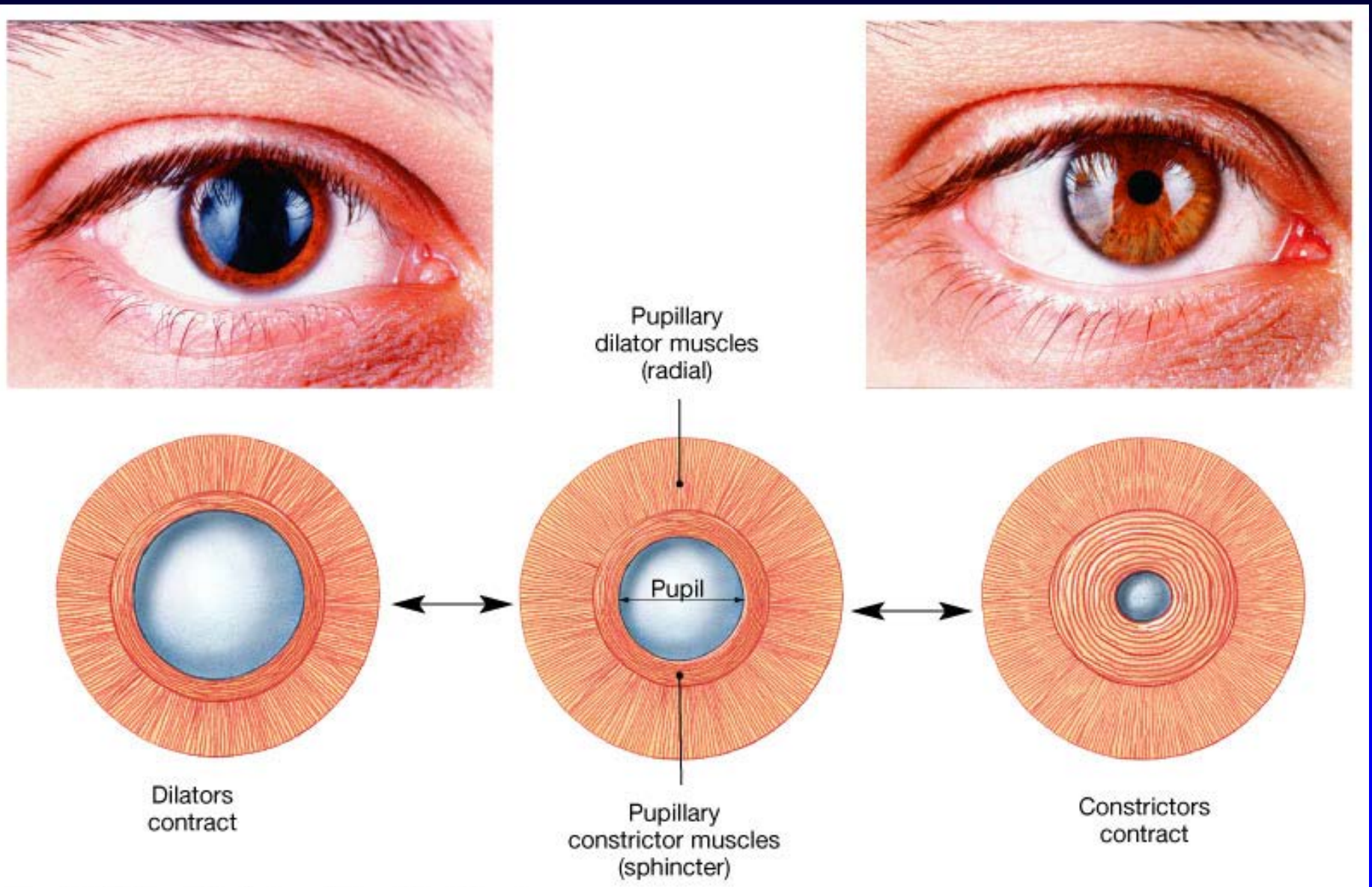
- The eye can only perceive a small portion of the spectrum of electromagnetic waves



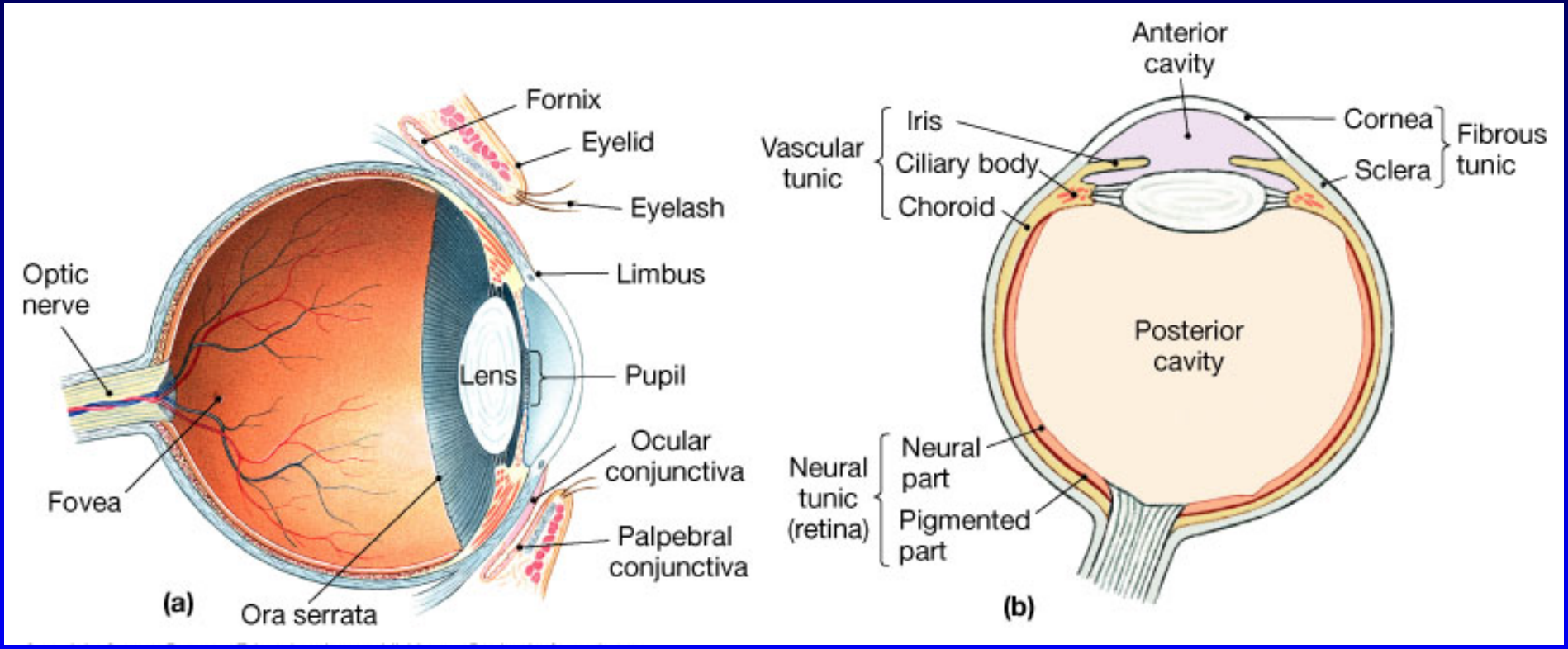
External Features and Accessory Structures of the Eye



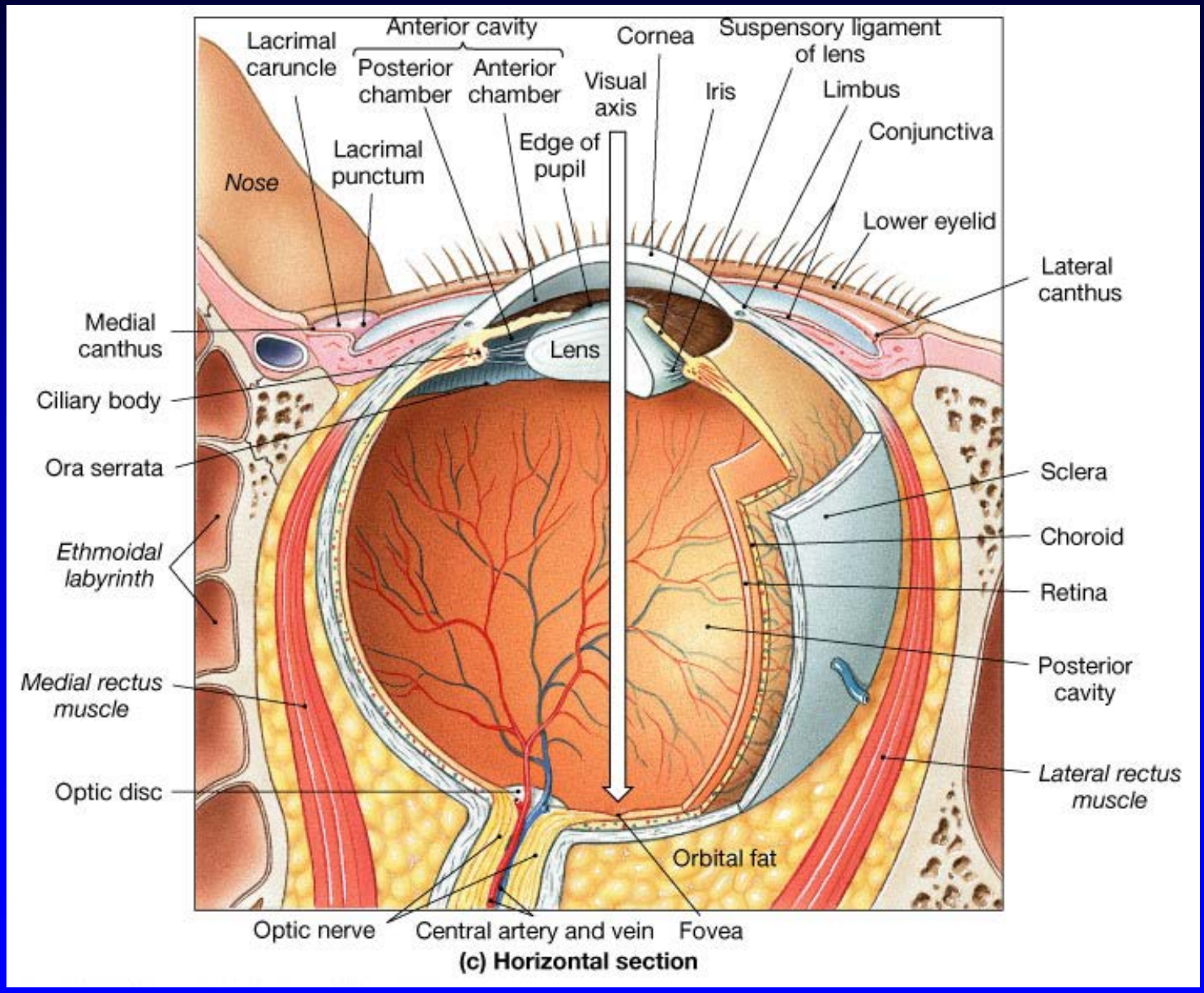
The Pupillary Muscles



The Sectional Anatomy of the Eye

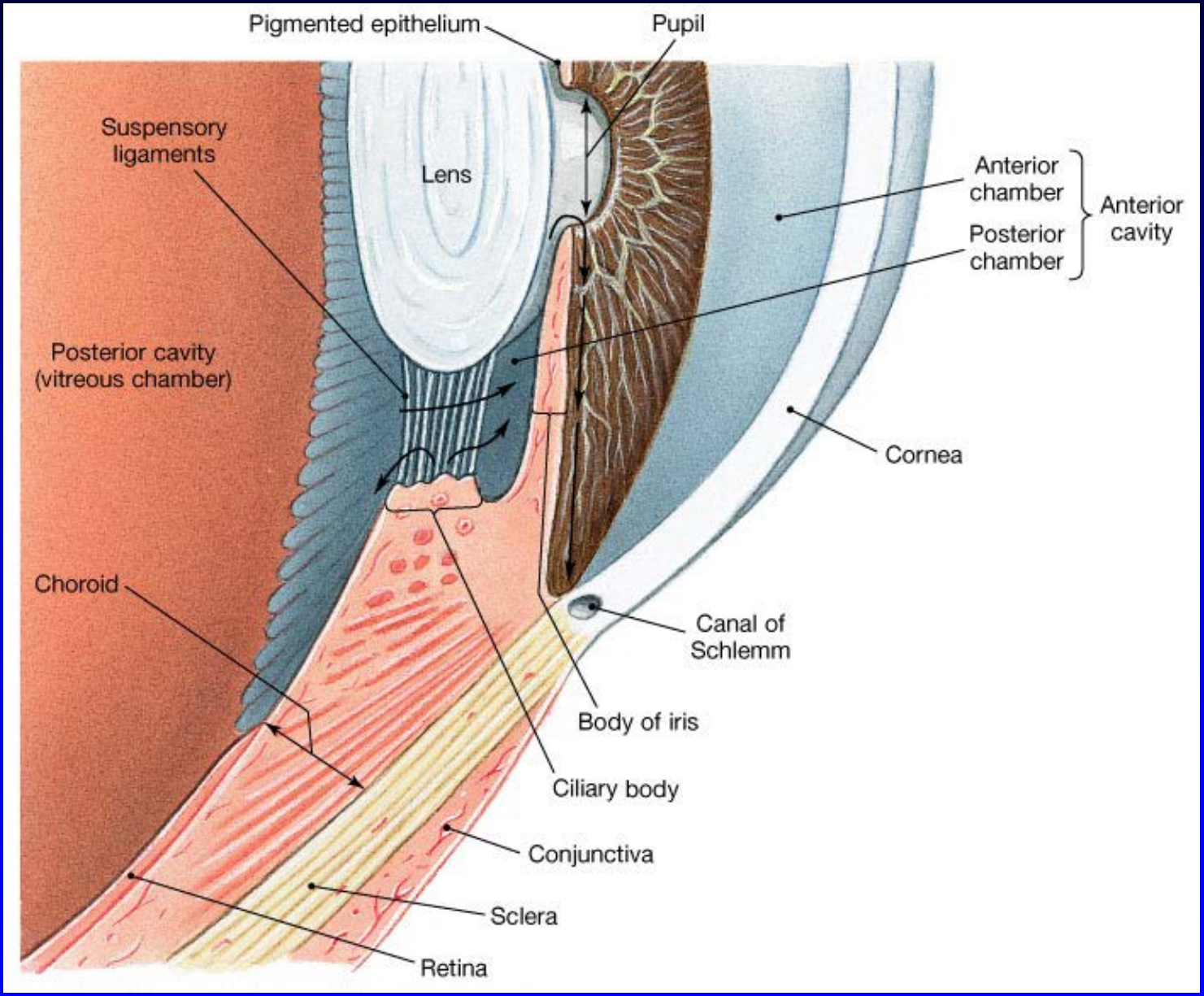


Sectional Anatomy of the Eye



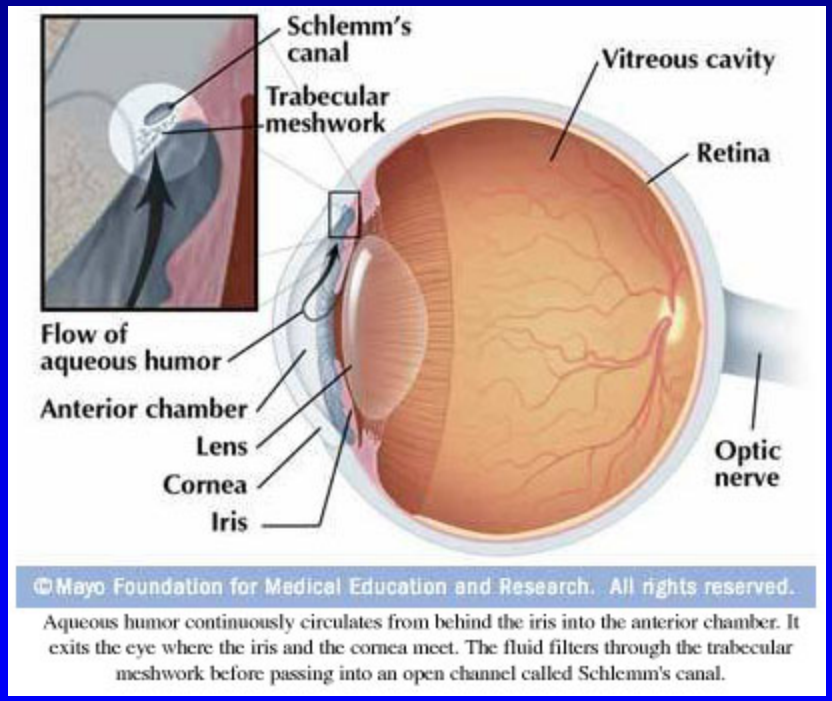
(c) Horizontal section

The Circulation of Aqueous Humor



Eye Abnormalities

- Glaucoma



Aqueous humor continuously circulates from behind the iris into the anterior chamber. It exits the eye where the iris and the cornea meet. The fluid filters through the trabecular meshwork before passing into an open channel called Schlemm's canal.

- Cataract

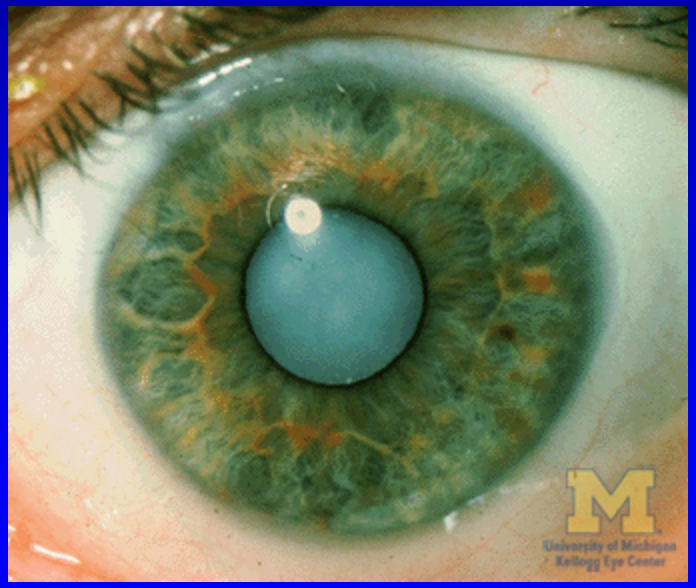
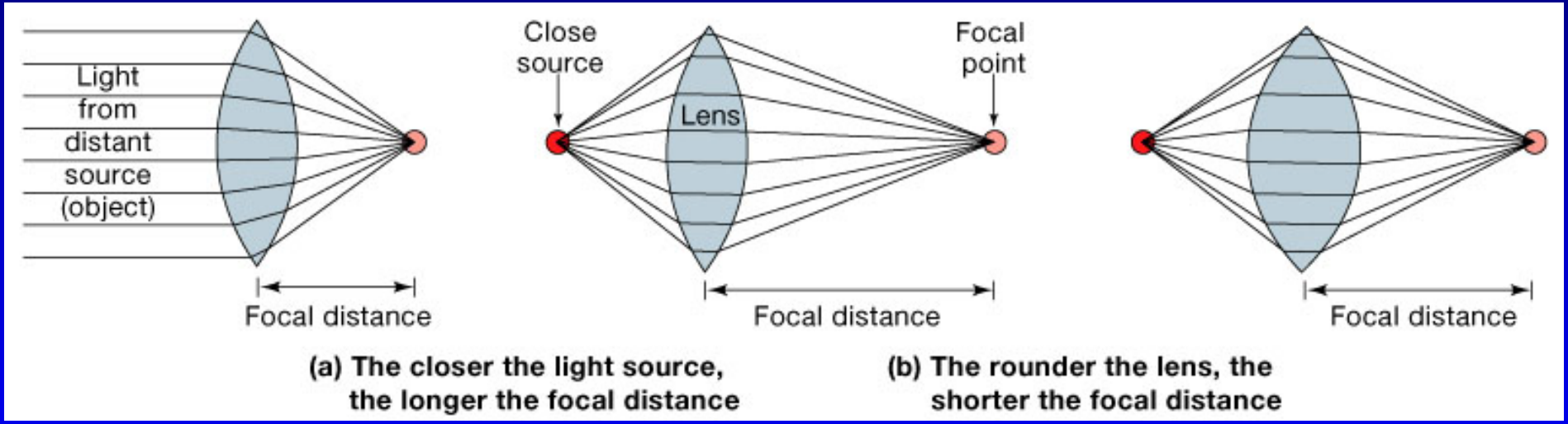


Image Formation

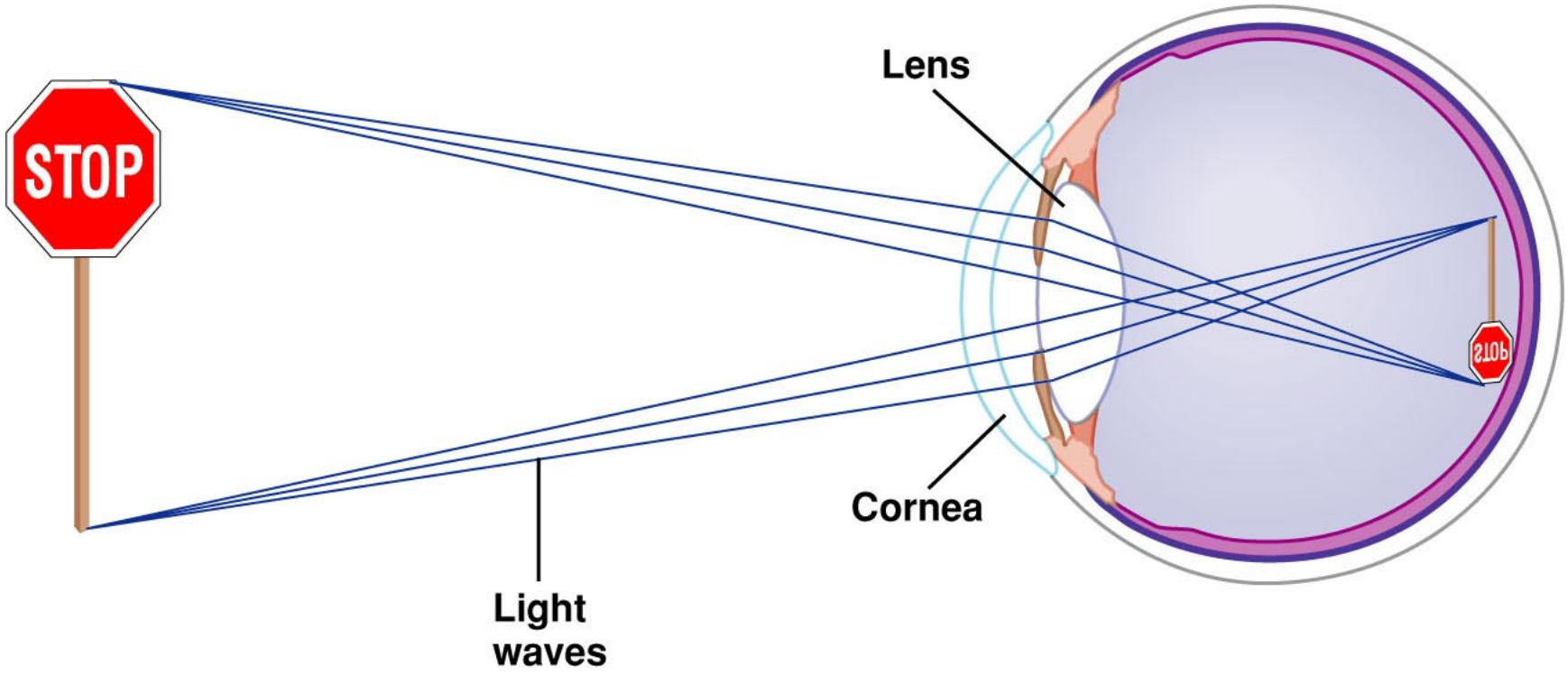


(a) The closer the light source, the longer the focal distance

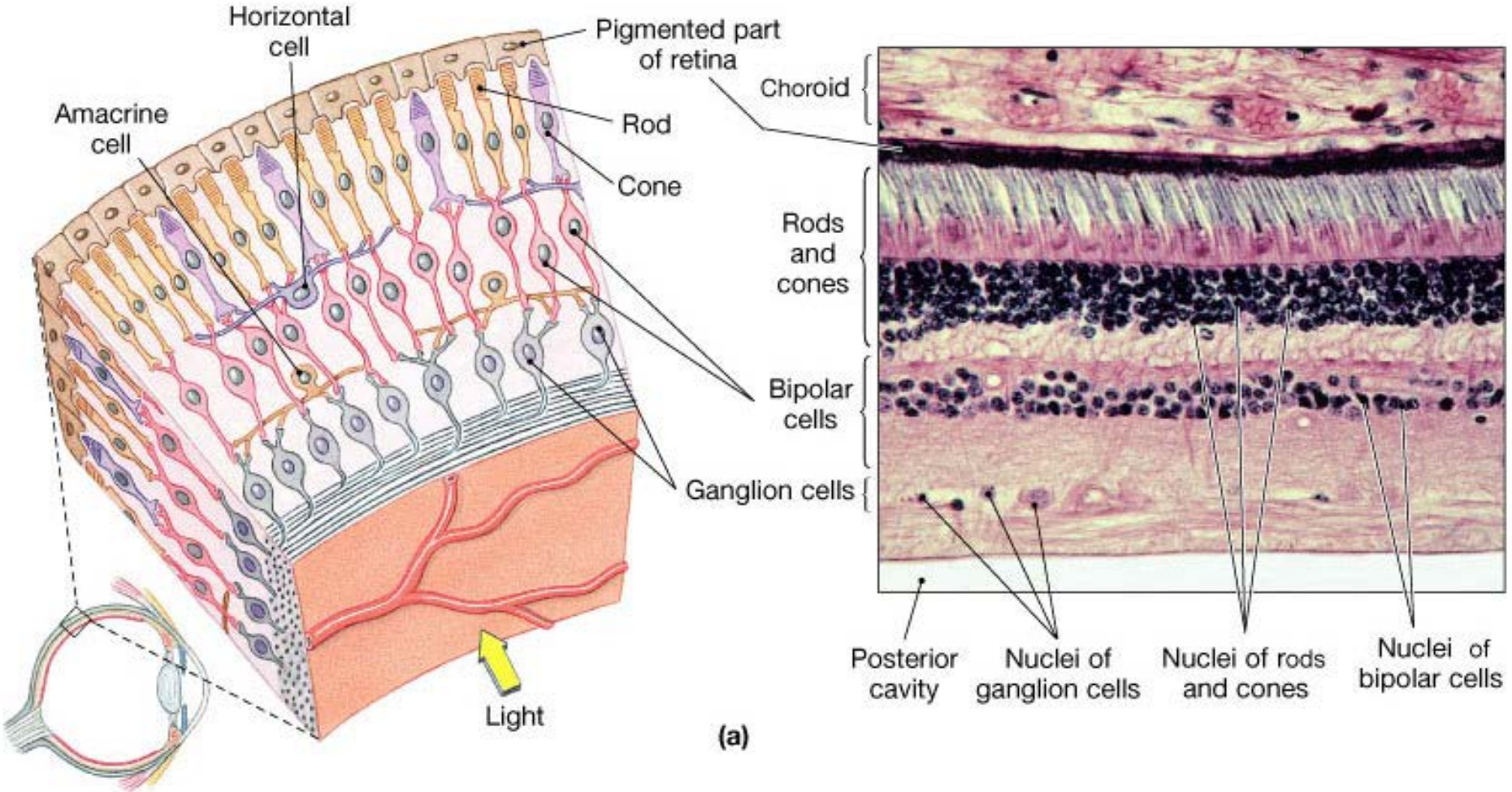
(b) The rounder the lens, the shorter the focal distance

Accommodation

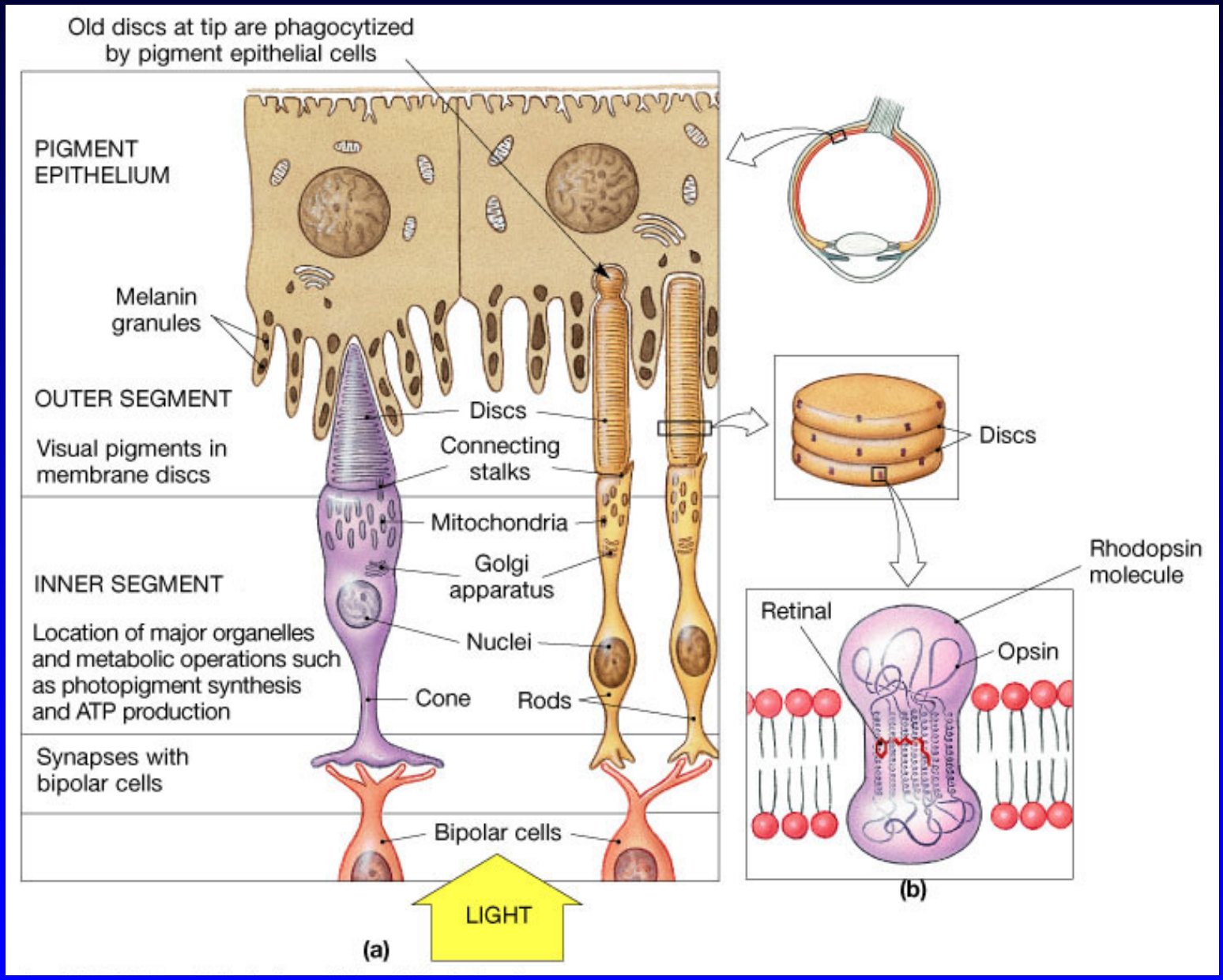
- It is the process of adjusting the shape of the lens so that the external image fall exactly on the retina



The Organization of the Retina



Rods and Cones



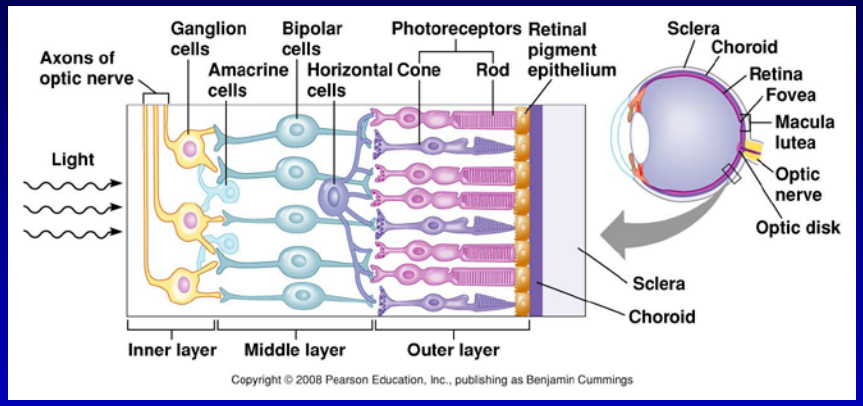
Retinal structure

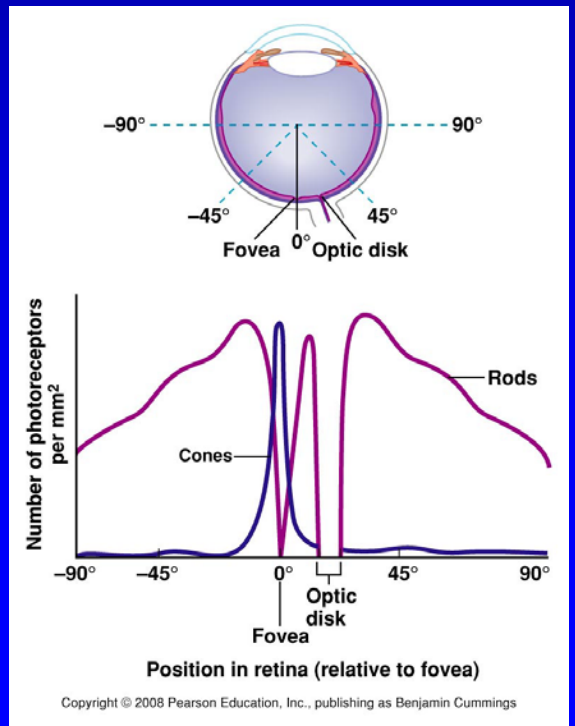
- Three cell layers:

-- outer layer: photoreceptors- rods and cones

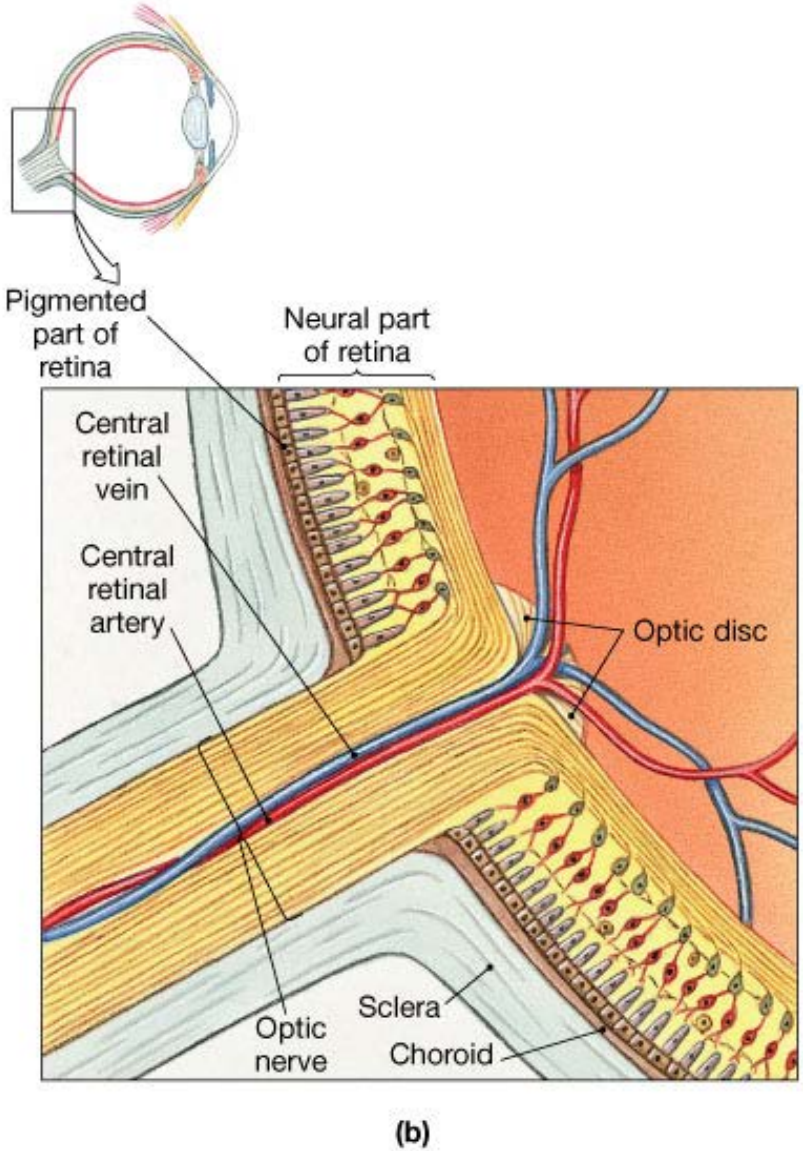
-- middle layer: bipolar neurons

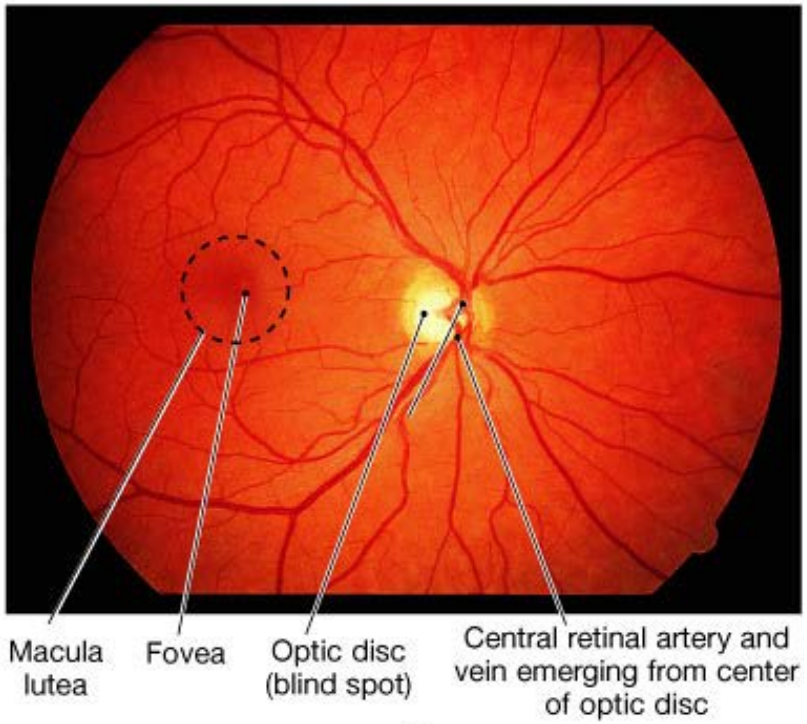
-- inner layer: ganglion cells



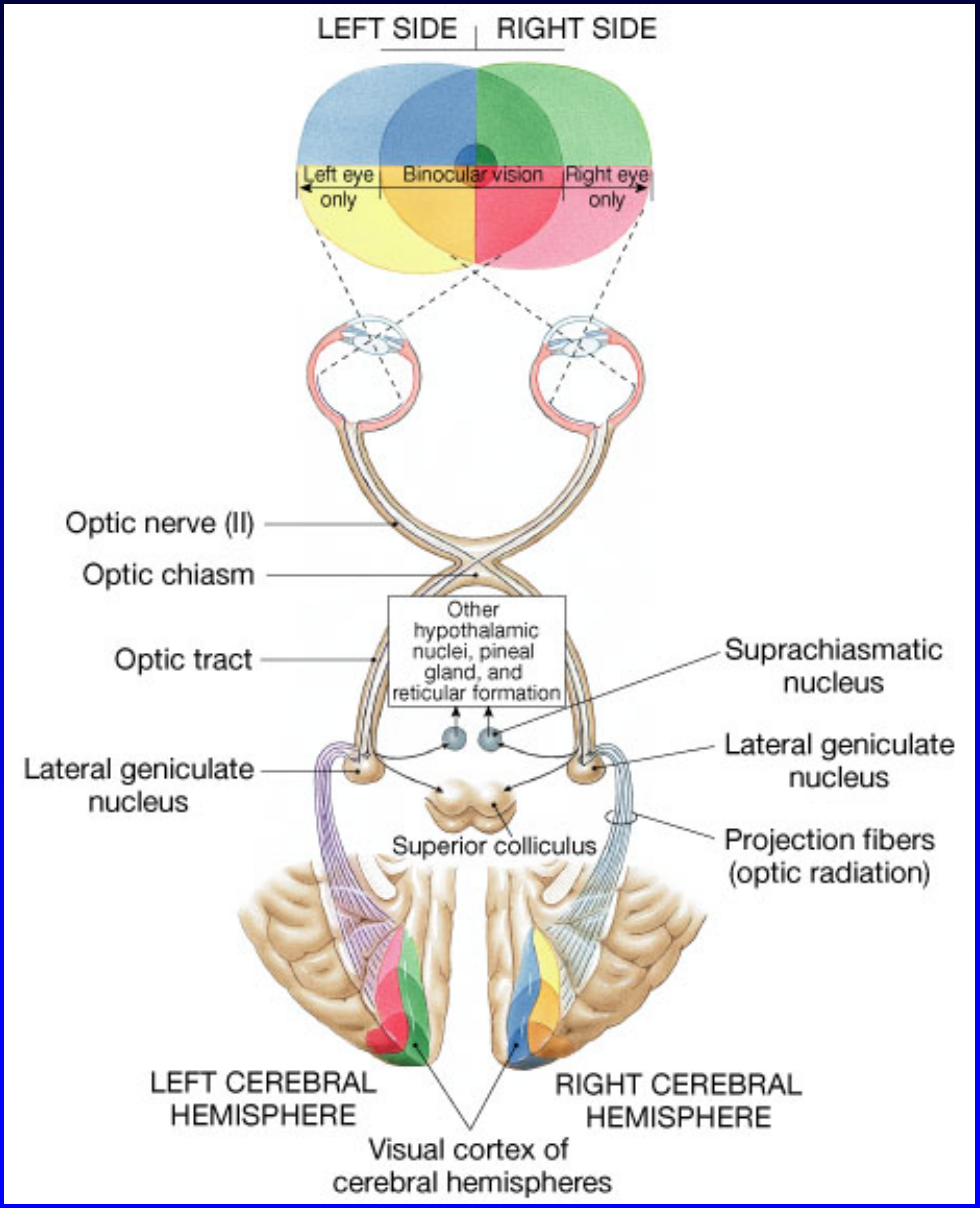


The Organization of the Retina





The Visual Pathways



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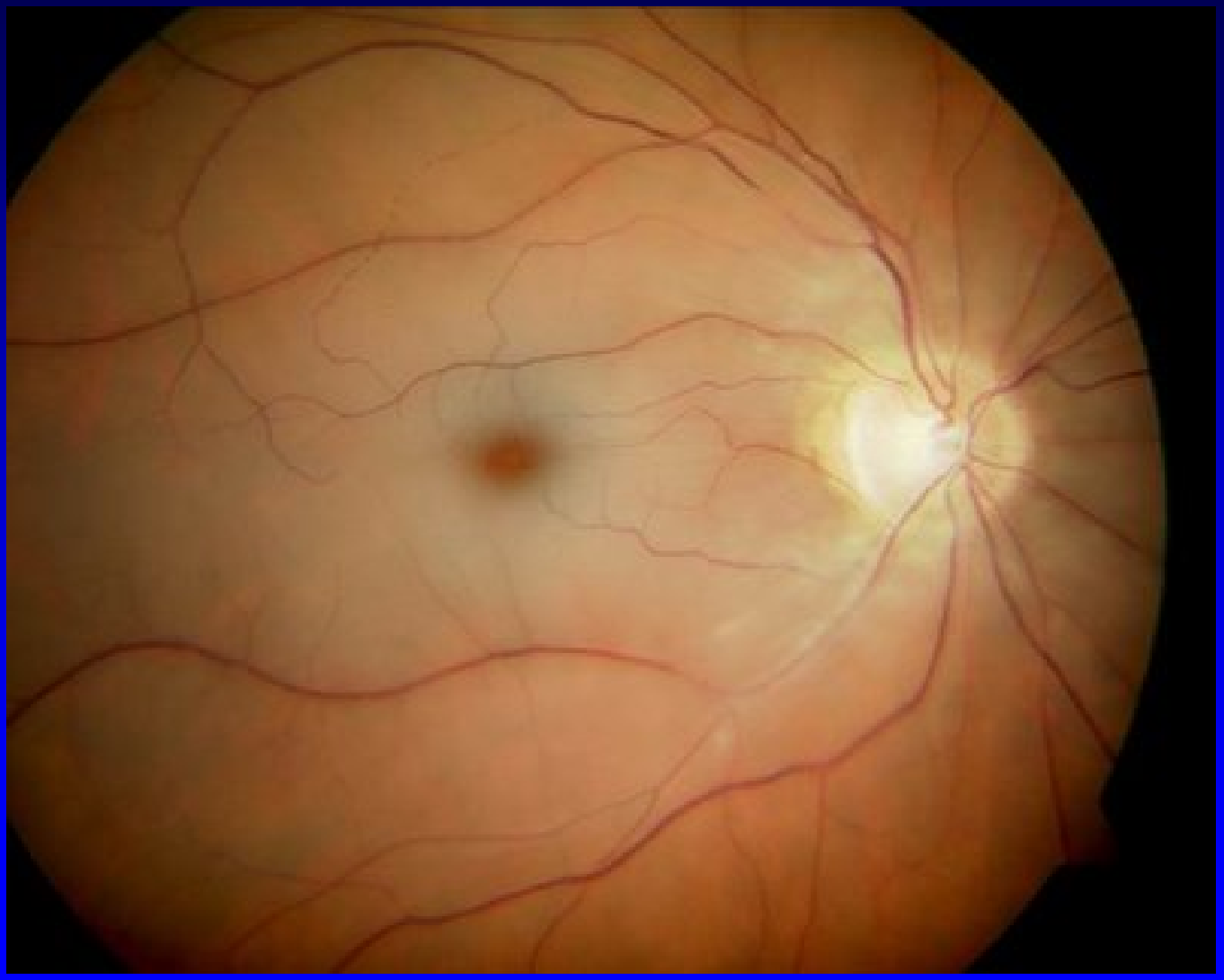
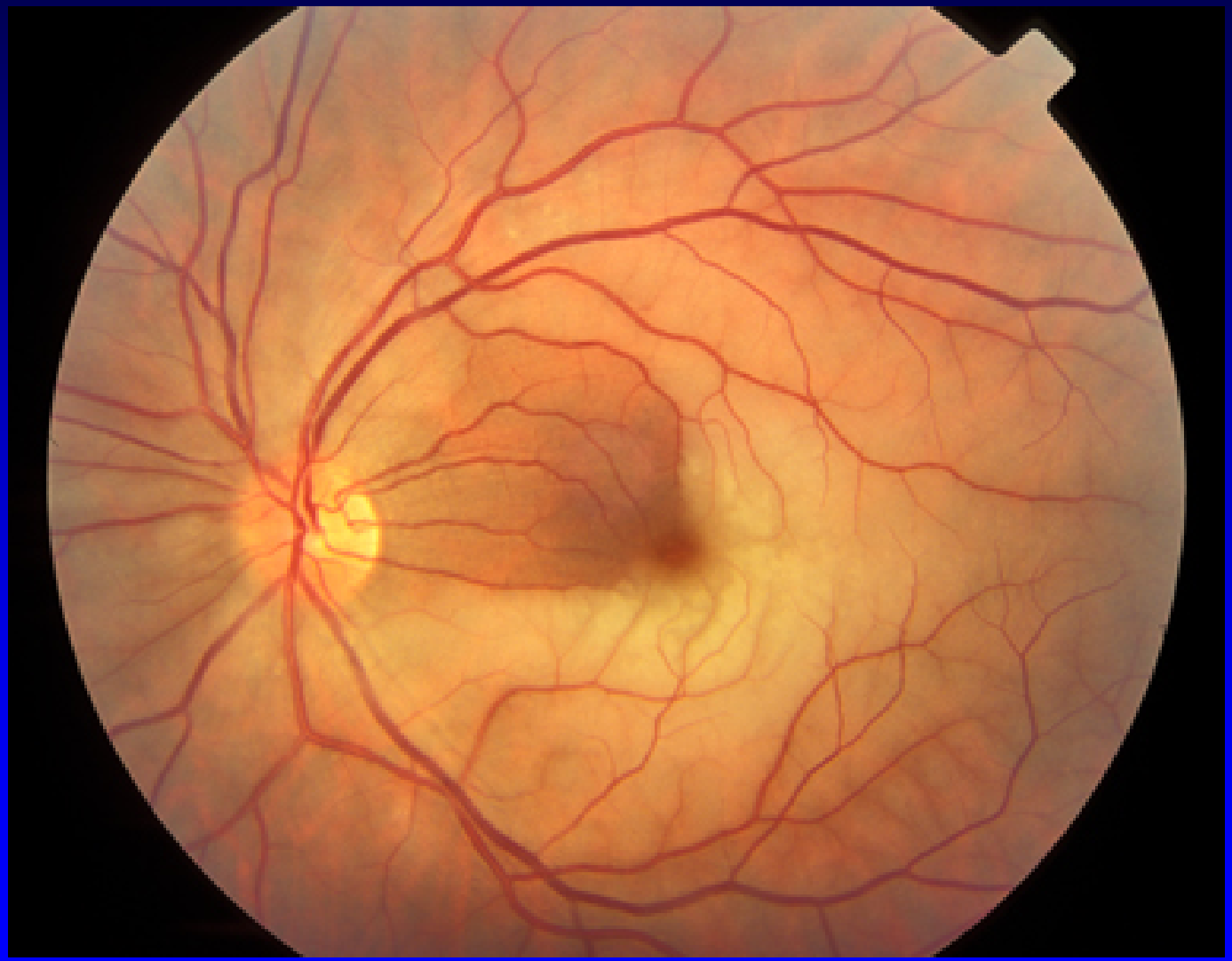
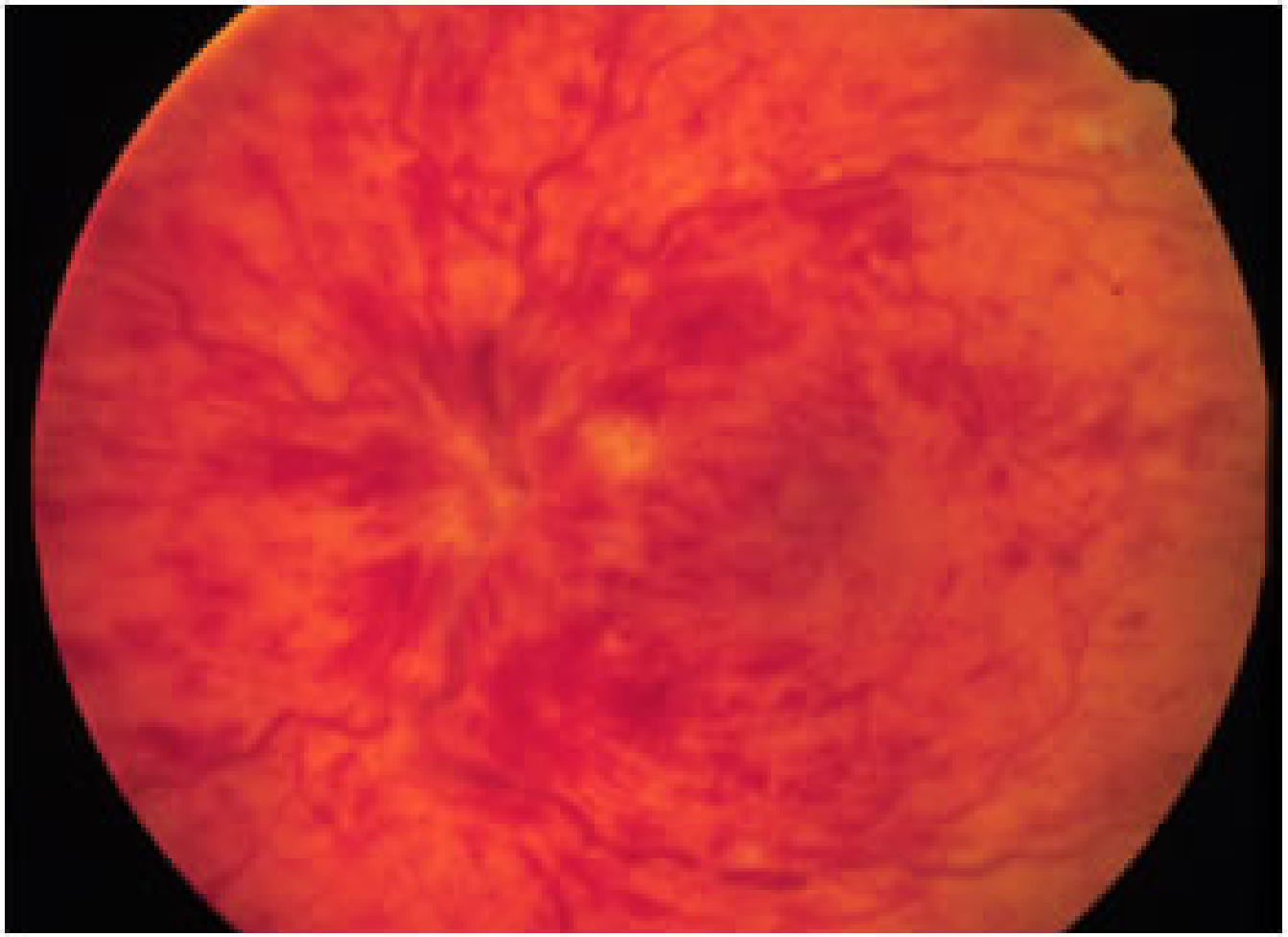
Central Retinal Artery Occlusion





Central Retinal Vein Occlusion



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Overview

- Dry AMD
- Wet AMD

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- Dry AMD
- Wet AMD

Vitamins for Dry AMD

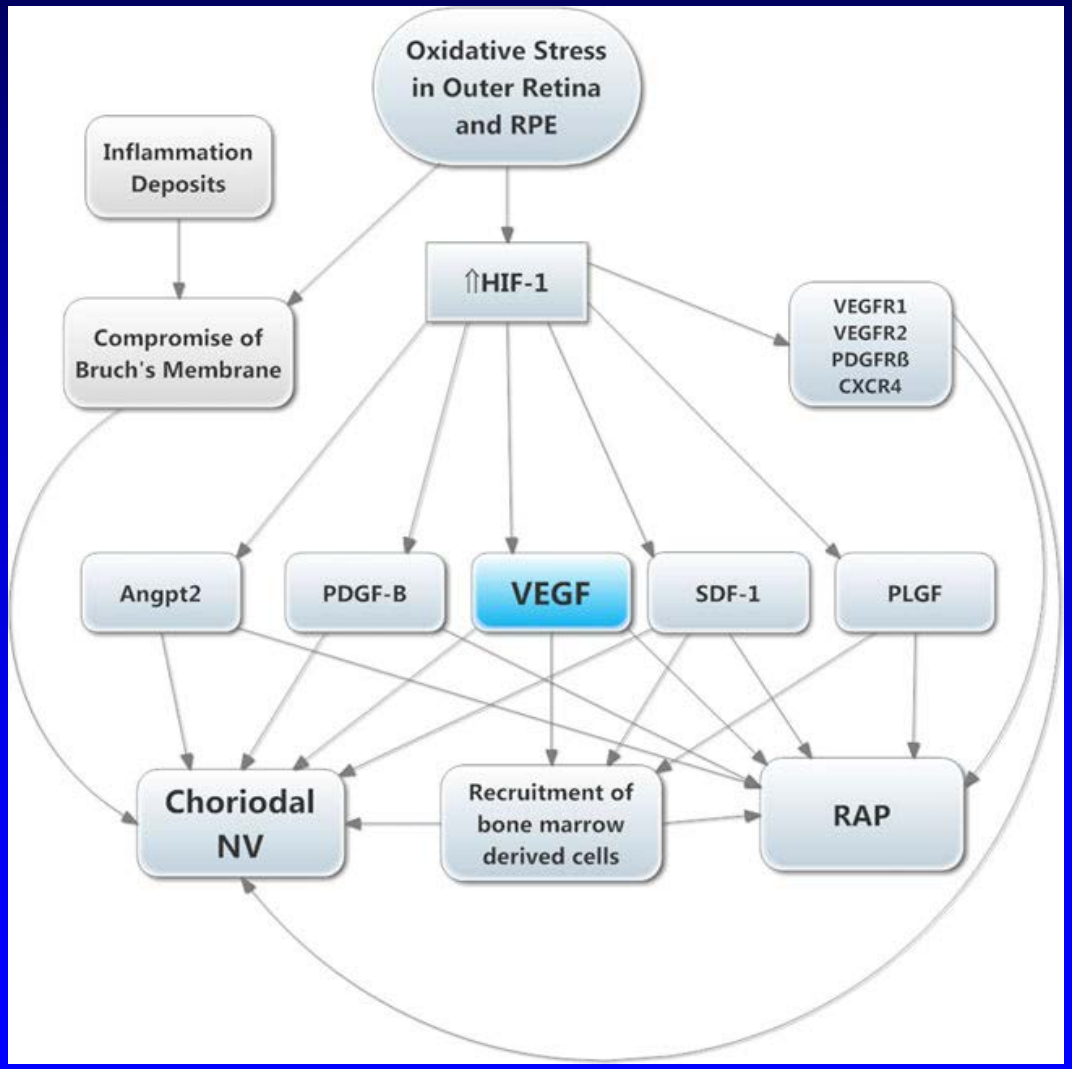
AREDS 2

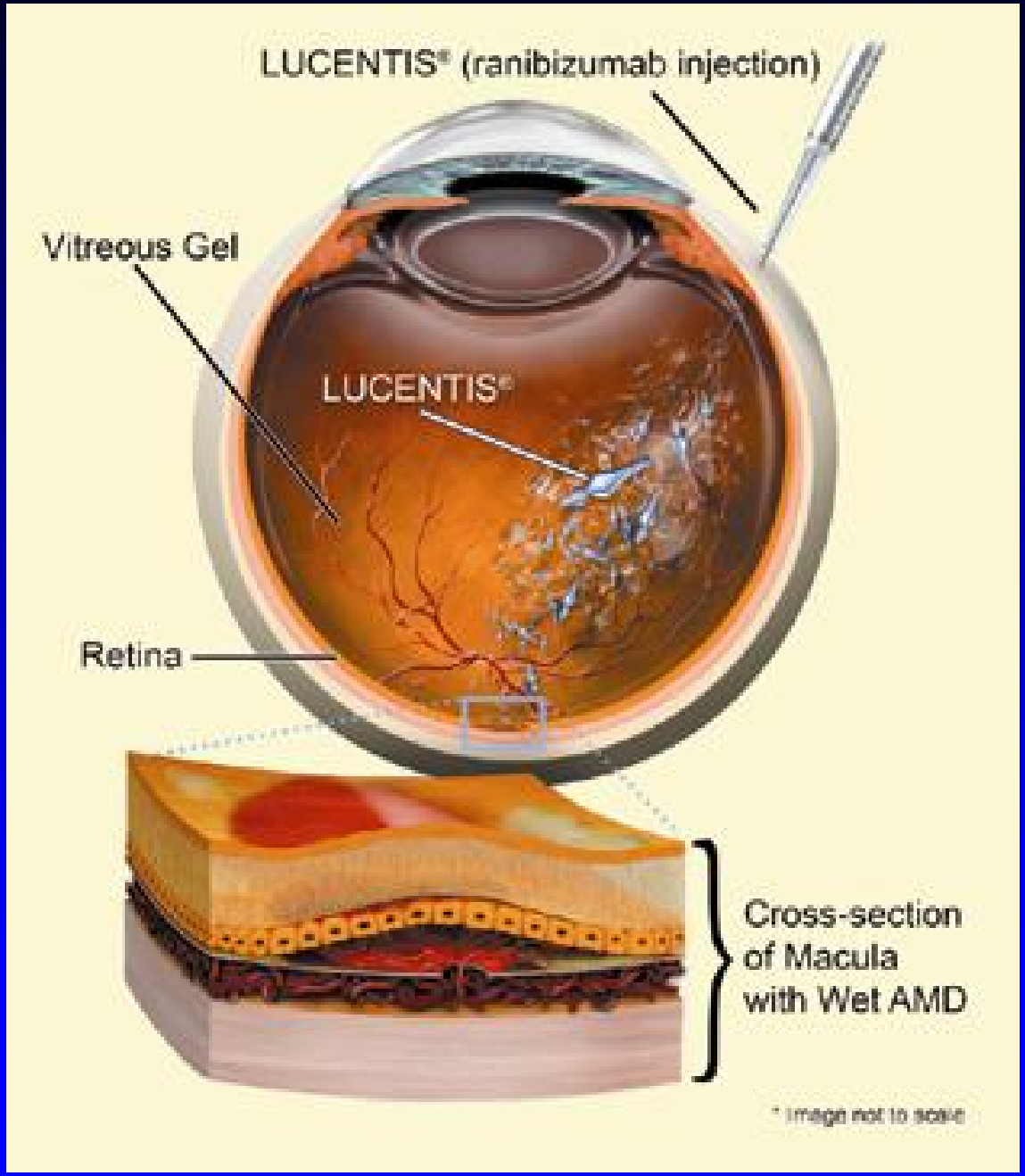
- Vitamin C - 500 mg
- Vitamin E - 400 IU
- Beta-Carotene - 15 mg [AREDS2 is testing without this too]
- Zinc - 80 mg
- Copper - 2 mg
- Lutein - 10 mg
- Zeaxanthin - 2 mg
- DHA - 350 mg
- EPA - 650 mg

Overview

- Dry AMD
- Wet AMD

Molecular Pathogenesis of CNV




LUCENTIS® (ranibizumab injection)
Vitreous Gel
LUCENTIS®
Retina
Cross-section
of Macula
with Wet AMD
* Image not to scale

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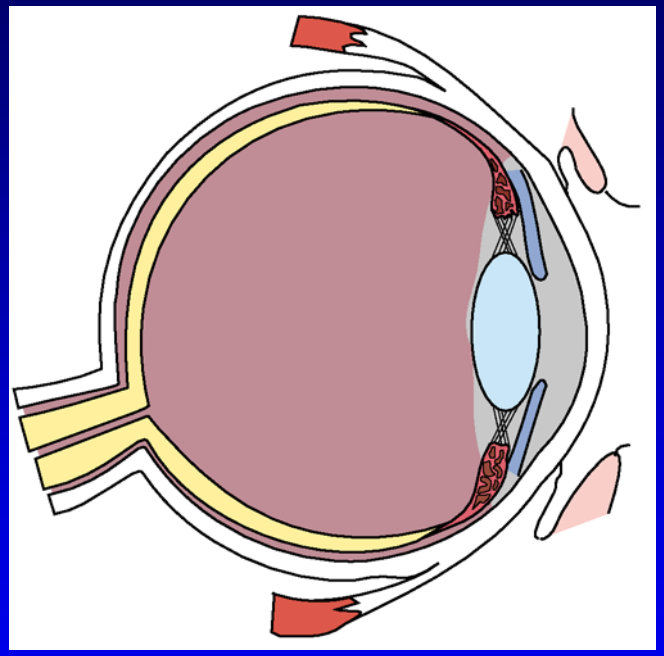
Diabetic Retinopathy



- Diabetic retinopathy is the most common cause of new cases of blindness among adults 20-74 years of age.
- Each year, between 12,000 to 24,000 people lose their sight because of diabetes.
- During the first two decades of disease, nearly all patients with type 1 diabetes and over 60% of patients with type 2 diabetes have retinopathy

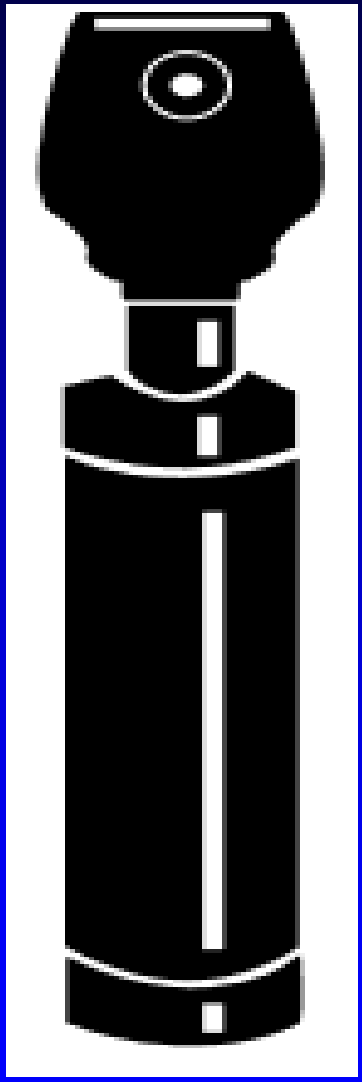
Risks of Diabetic Retinopathy Related Vision Loss

- **Duration of diabetes disease**
  - **WESDR demonstrated that type 1 patients experience a 25% rate of retinopathy after 5 years of disease, and 80% at 15 years of disease[1]**
  - **Up to 21% of newly diagnosed type 2 patients have some degree of retinopathy at time of diagnosis[1]**
- **Puberty**
- **Pregnancy**
- **Lack of appropriate ophthalmic examination**

[1]American Diabetes Association: Retinopathy in Diabetes (Position Statement). *Diabetes Care* 27 (Suppl.1): S84-S87, 2004

Retinopathy Screening

- Type 1 diabetes - screen within 3-5 years of diagnosis after age 10[1]
- Type 2 diabetes - screen at time of diagnosis[1]
- Pregnancy - women with preexisting diabetes should be screened prior to conception and during first trimester[1]
- Follow-up annually; less frequent exams (2-3 yrs) may be considered[1]
- Examination Methods - Dilated indirect ophthalmoscopy coupled with biomicroscopy and seven-standard field steroscopic 30˚ fundus photography[1]

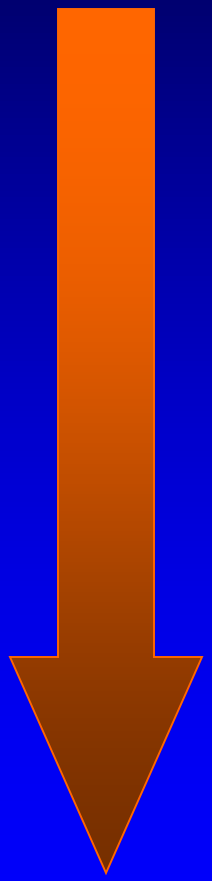


[1]American Diabetes Association: Retinopathy in Diabetes (Position Statement). *Diabetes Care* 27 (Suppl.1): S84-S87, 2004

CLINICAL CLASSIFICATION OF DIABETIC RETINOPATHY

- Background
- Pre-proliferative
- Proliferative
- End-stage diabetic eye disease

Natural History of Diabetic Retinopathy



- Mild nonproliferative diabetic retinopathy (NPDR)
- Moderate NPDR
- Severe NPDR
- Very Severe NPDR
- Proliferative diabetic retinopathy (PDR)

Mild NPDR

- **Clinical Findings**
  - Increased vascular permeability
  - Microaneurysms
  - Intraretinal hemorrhages
  - Clinically Significant Macular Edema (CSME) possible
- **Management/Treatment**
  - Annual follow-up
  - If CSME present: color fundus photography, fluorescein angiography, and photocoagulation

Moderate NPDR

- **Clinical Findings**
  - Venous caliber changes
  - Intraretinal Microvascular Abnormalities (IRMAs)
  - CSME possible
- **Management/Treatment**
  - 6-12 month follow-up without CSME
  - Color fundus photography
  - CSME present: color fundus photography, fluorescein angiography, focal photocoagulation, 3-4 month follow-up

Severe/Very Severe NPDR

- **Clinical Findings**
  - Retinal ischemia
  - IRMAs
  - Extensive hemorrhage and microaneurysms
  - CSME possible
- **Management/Treatment**
  - 3-4 month follow-up
  - Color fundus photography
  - Possible panretinal photocoagulation
  - CSME present: color fundus photography, fluorescein angiography, focal photocoagulation, 3-4 month follow-up

PDR

- **Clinical Findings**
  - **Ischemia induced neovascularization**
    - **at the optic disk (NVD)**
    - **elsewhere in the retina (NVE)**
  - **Vitreous hemorrhage**
  - **Retinal traction, tears, and detachment**
  - **CSME possible**

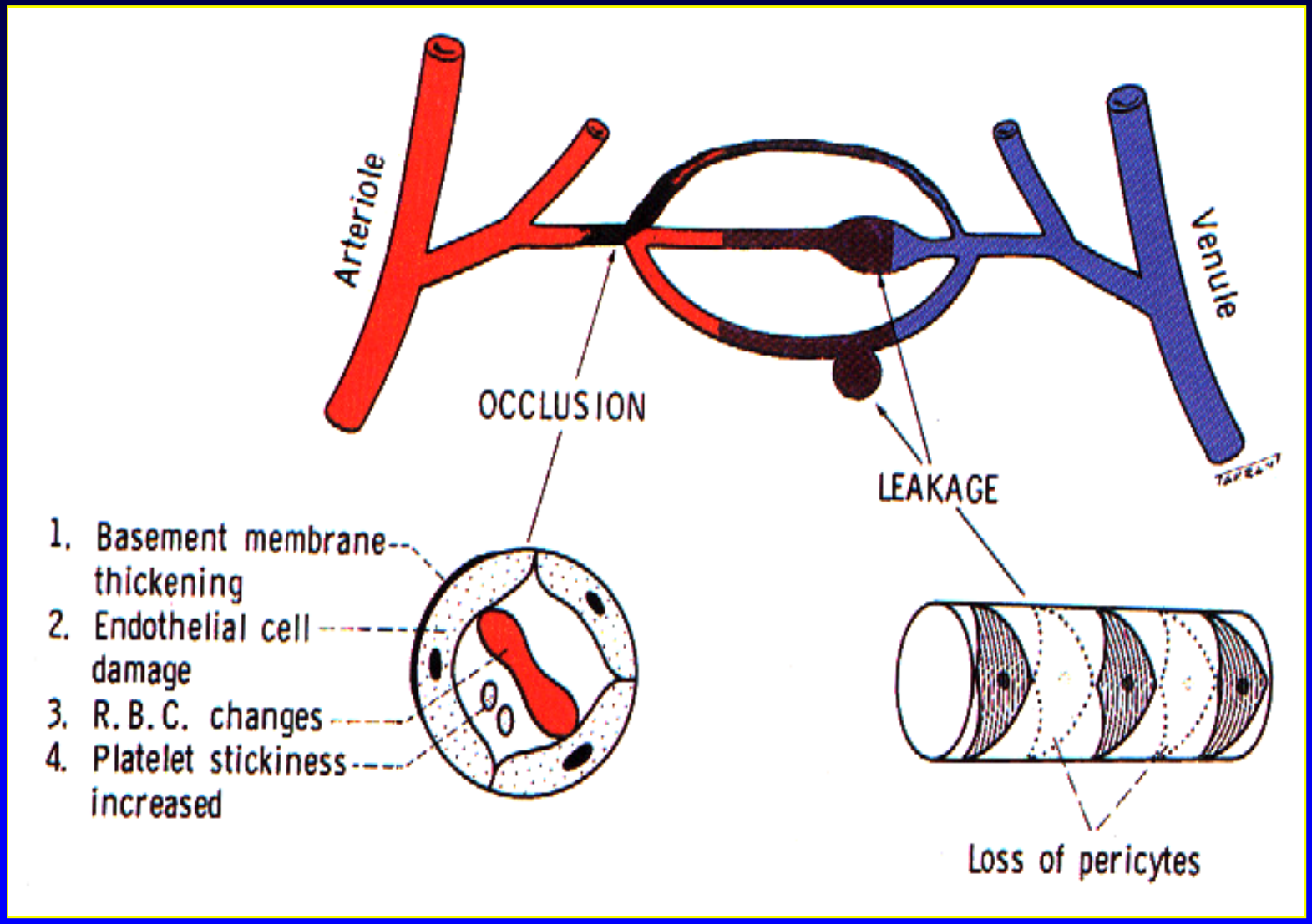
PDR, cont.

- **Management/Treatment**
  - 2-4 month follow-up
  - Color fundus photography
  - Panretinal photocoagulation (3-4 month follow-up)
  - Vitrectomy
  - CSME present: focal photocoagulation, fluorescein angiography

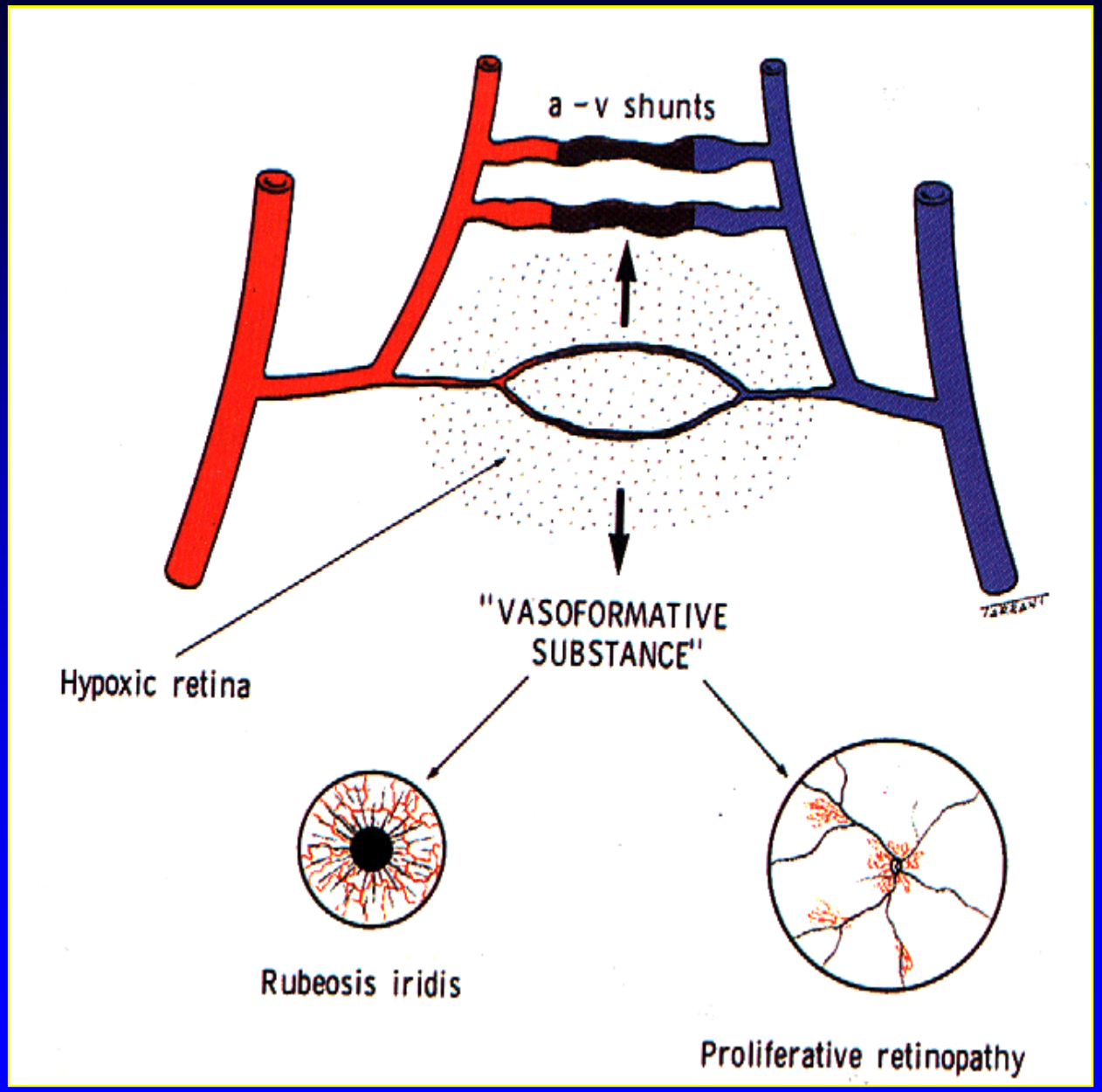
Prevention of Diabetic Retinopathy Associated Vision Loss

- Intensive glycemic control
- Tight blood pressure control (<130/80 mmHg)
- Comprehensive eye examinations

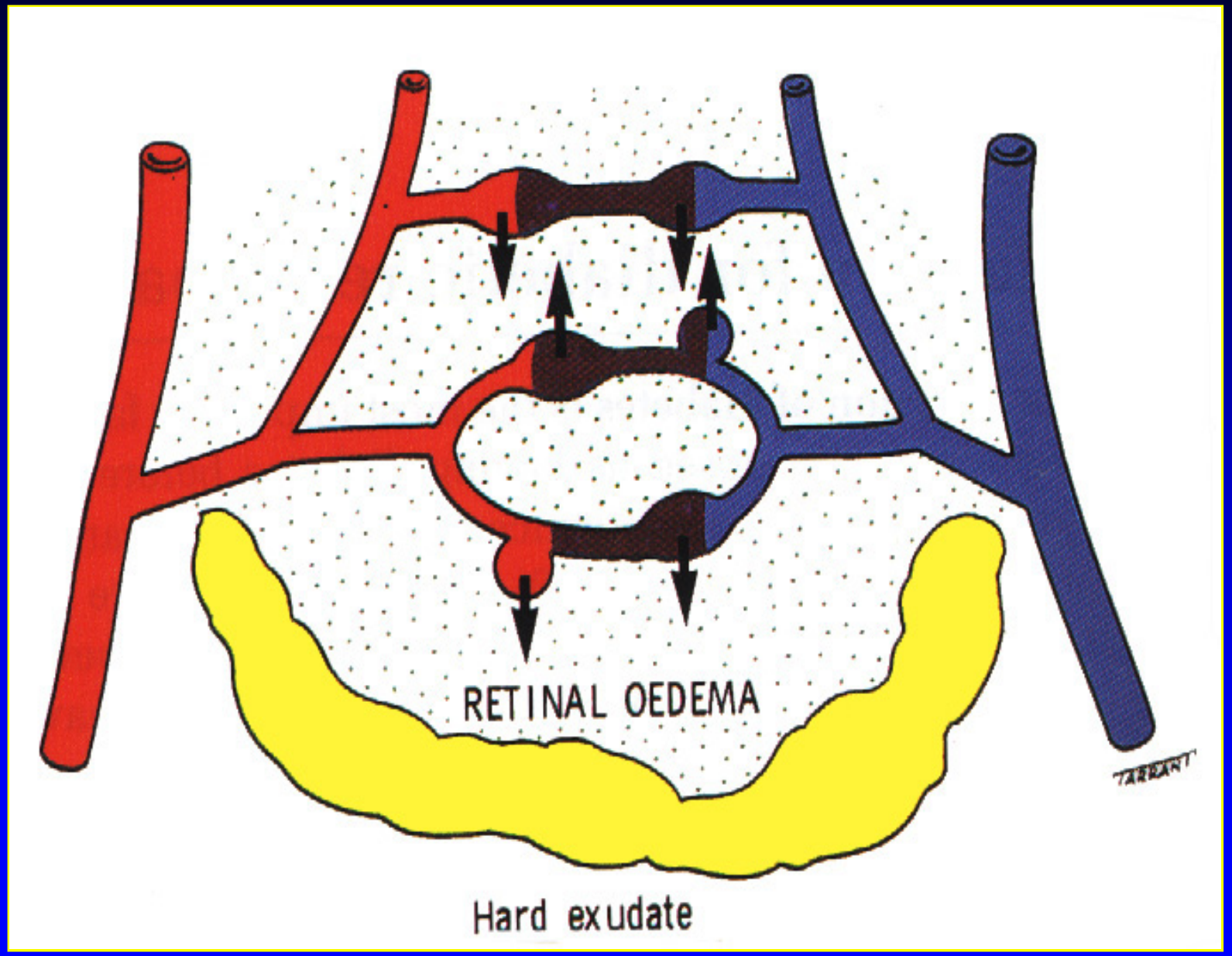
Pathogenesis of diabetic retinopathy



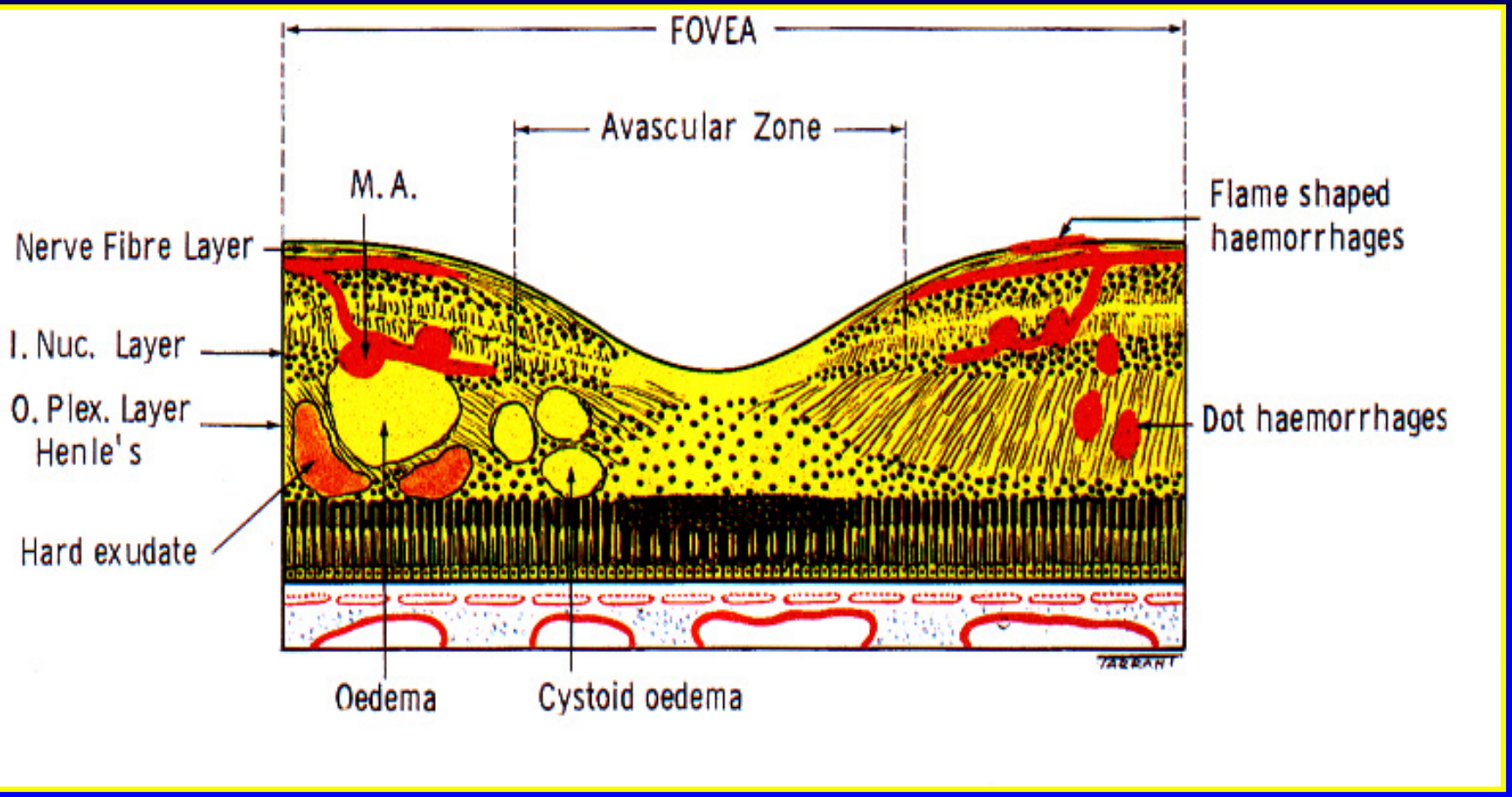
Consequences of retinal ischaemia



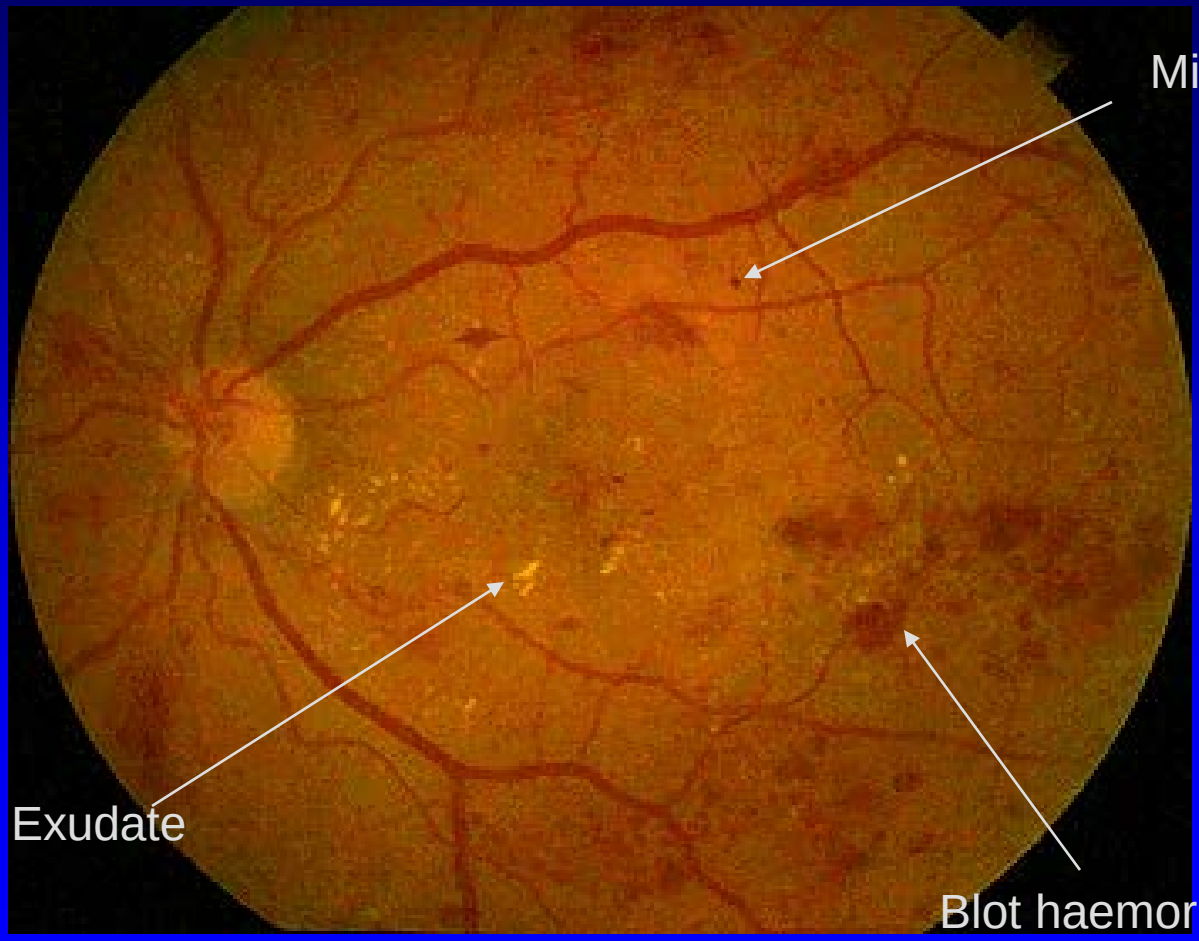
Consequences of chronic leakage



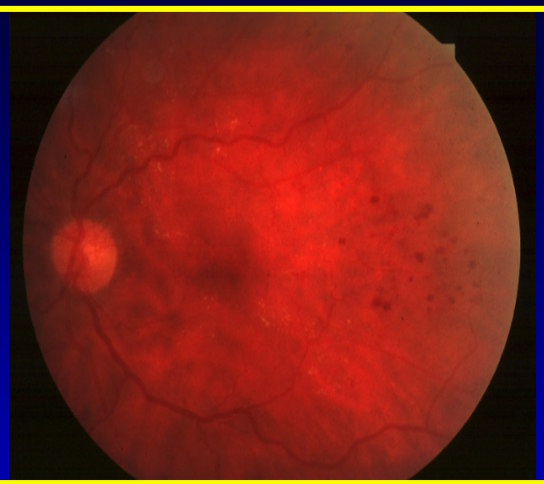
Location of lesions in background diabetic retinopathy



Background



Signs of background diabetic retinopathy

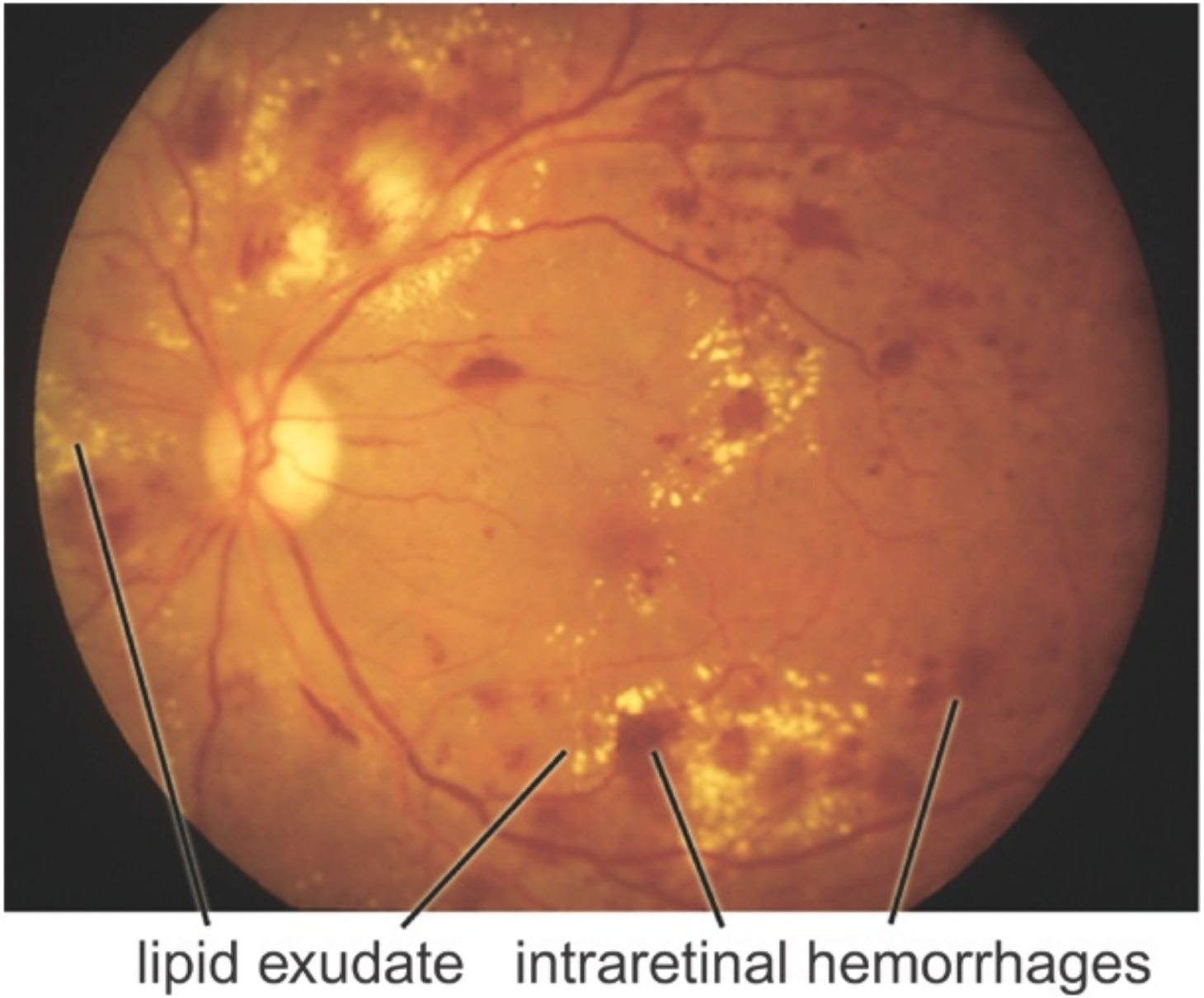


Microaneurysms usually temporal to fovea

Intraretinal dot and blot hemorrhages

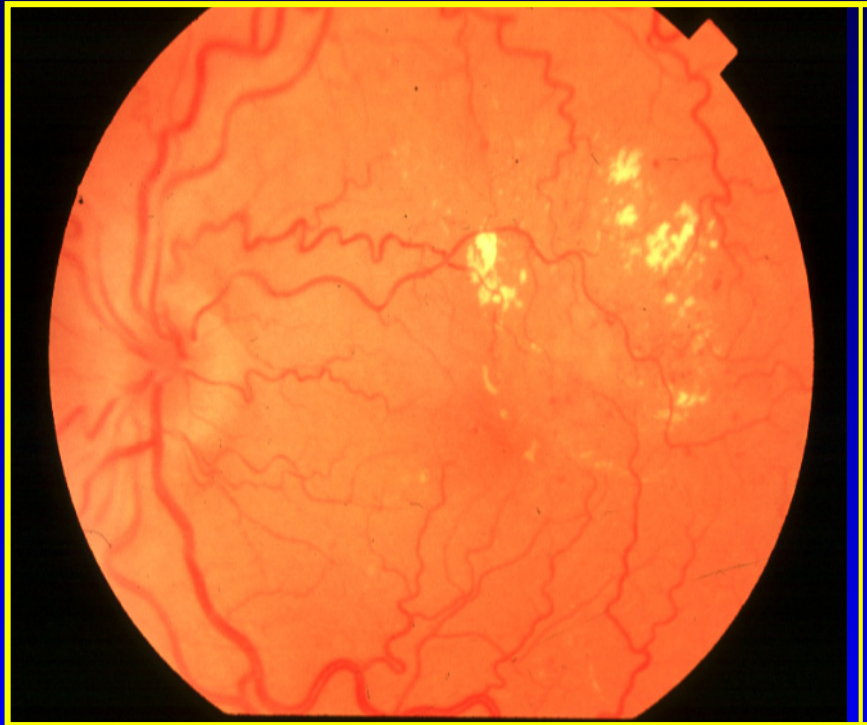
Hard exudates frequently arranged in clumps or rings

Retinal edema seen as thickening on biomicroscopy

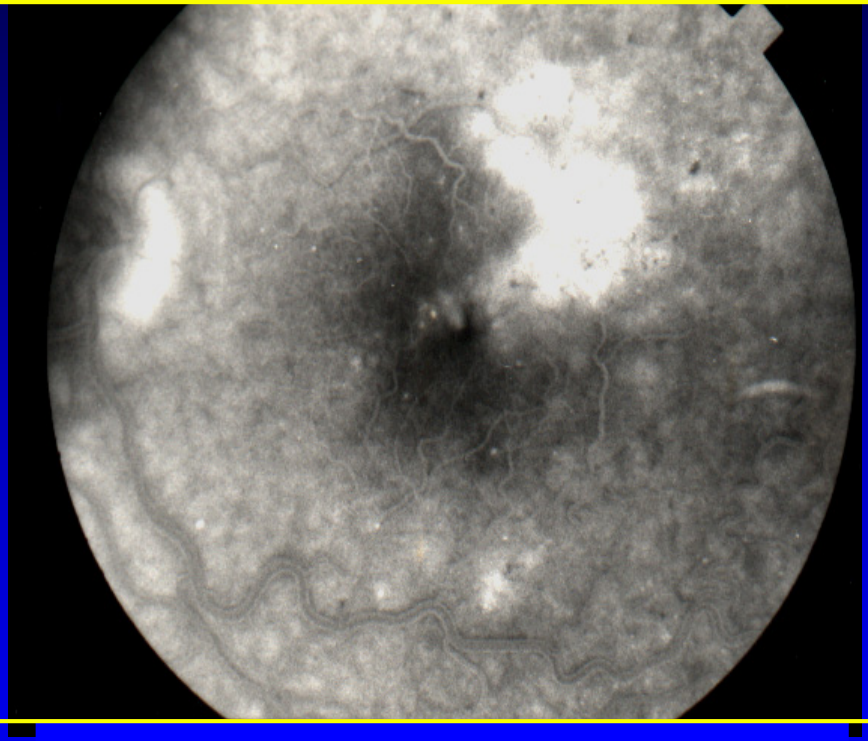


(From Kaiser PK, Friedman NJ, Pineda R II: *Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology*, 2nd ed, Philadelphia, Saunders, 2004.)

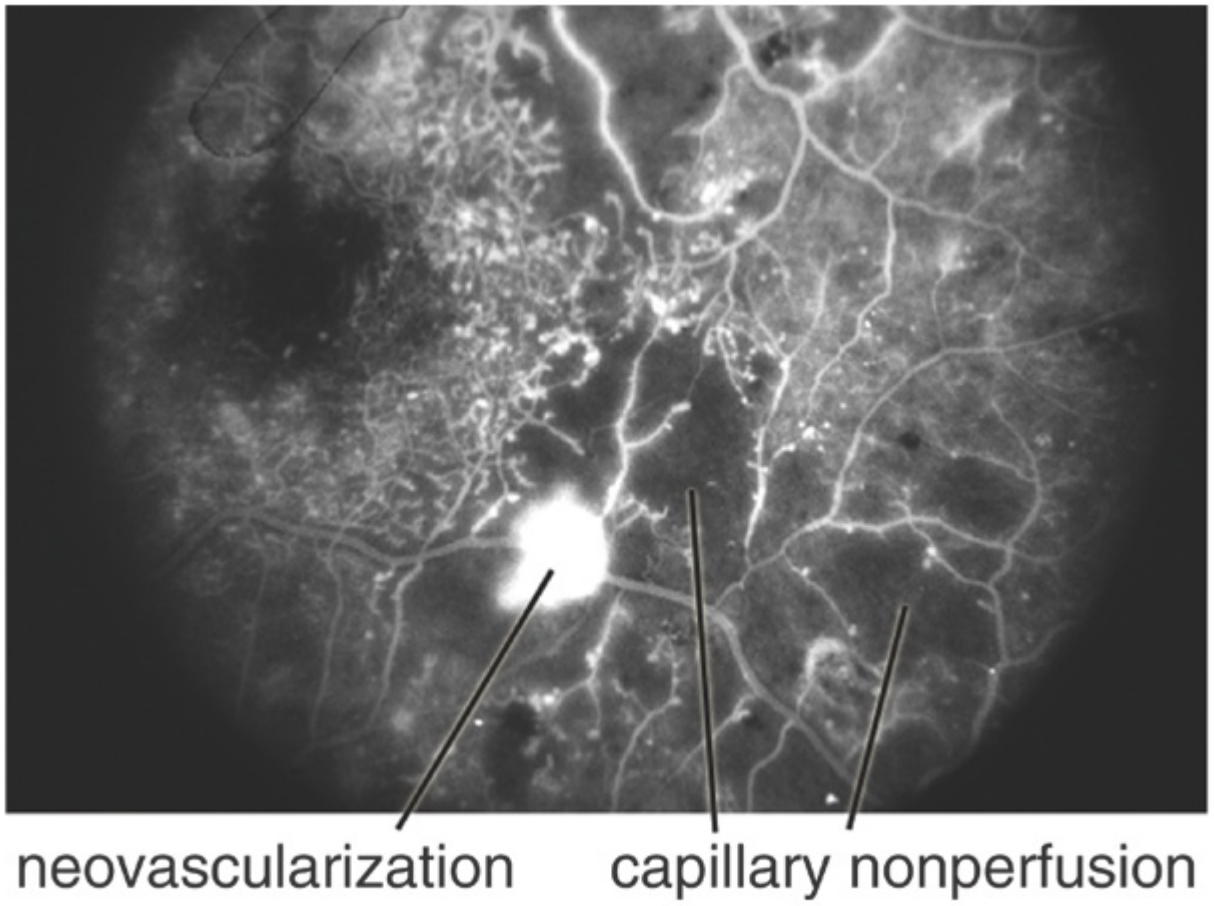
Focal diabetic maculopathy



- Circumscribed retinal thickening
- Associated complete or incomplete circinate hard exudates



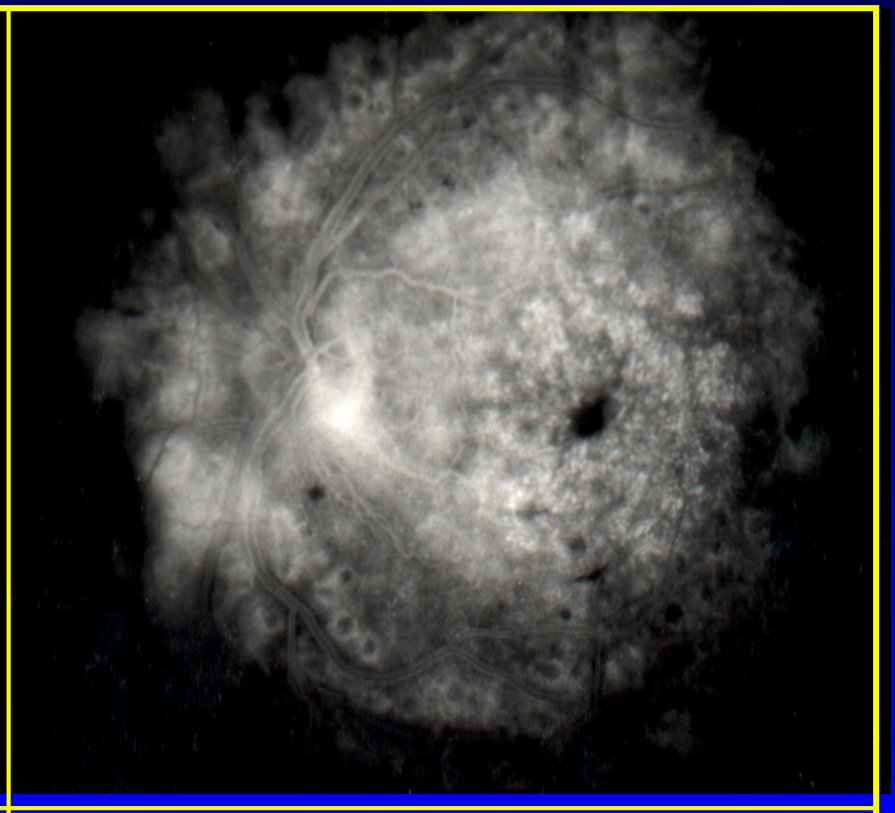
- Focal leakage on FA
- Focal photocoagulation
- Good prognosis



(From Kaiser PK, Friedman NJ, Pineda R II: *Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology*, 2nd ed, Philadelphia, Saunders, 2004.)

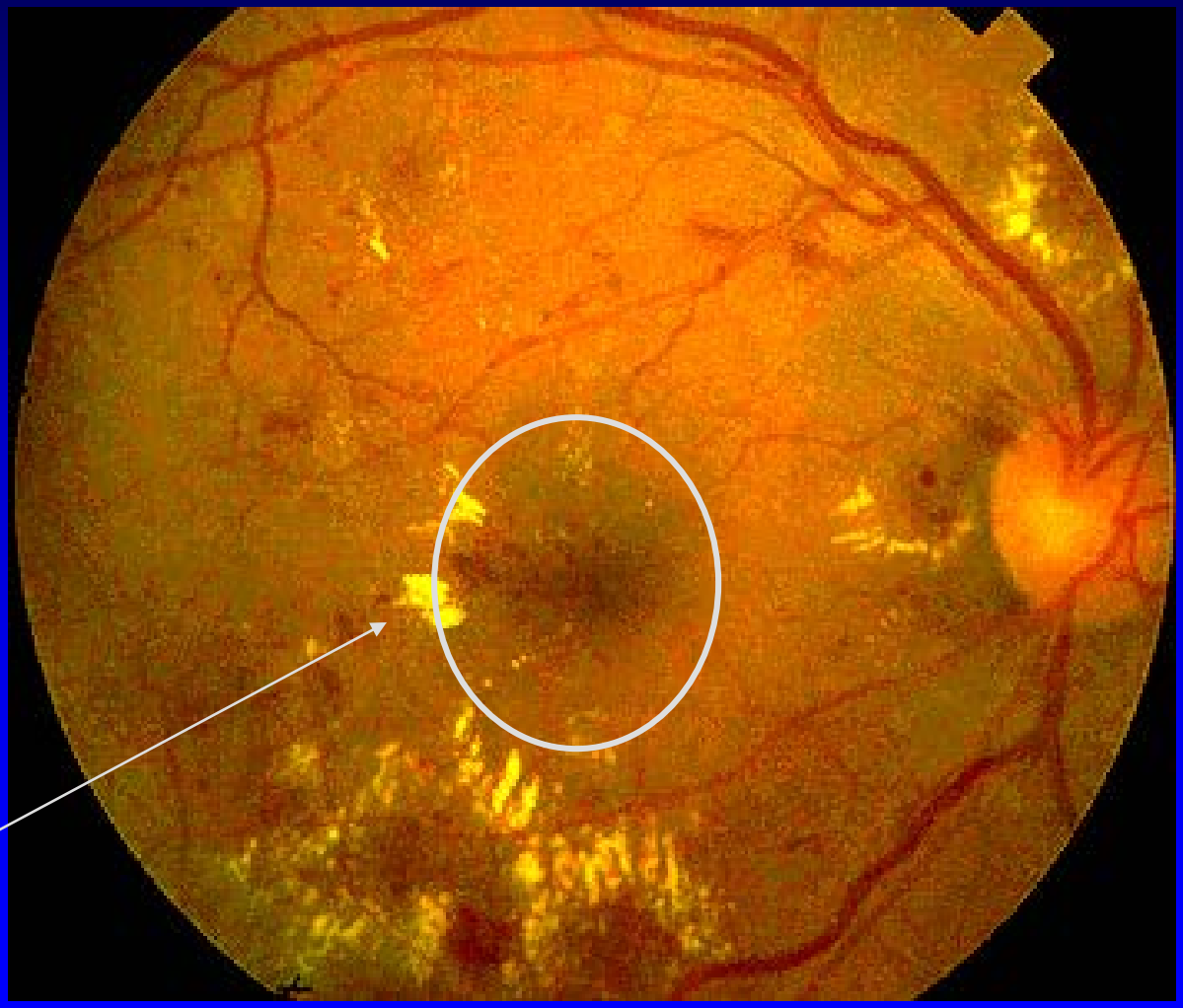
Diffuse diabetic maculopathy

- Diffuse retinal thickening
- Frequent cystoid macular edema
- Variable impairment of visual acuity

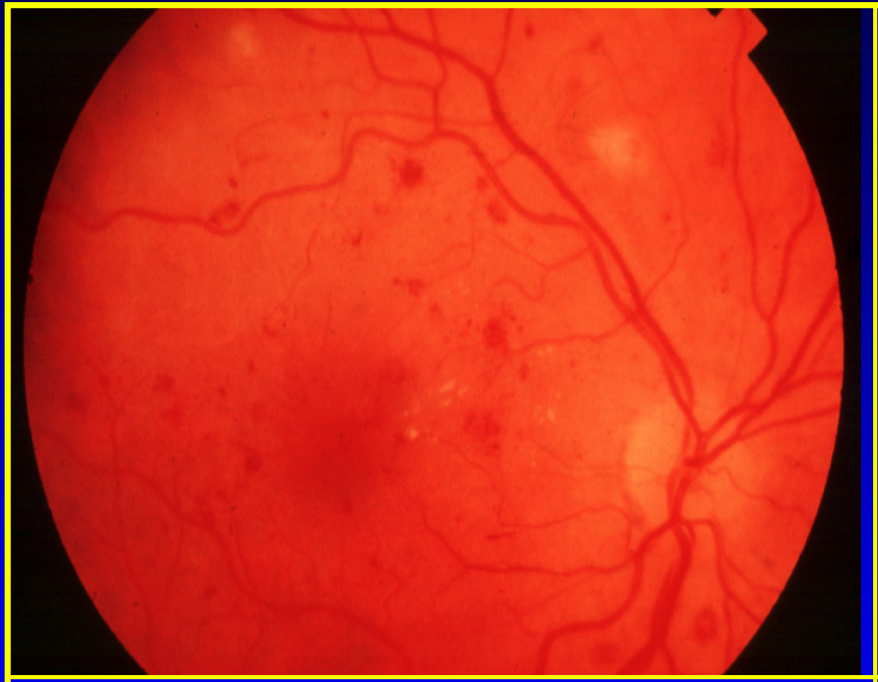


- Generalized leakage on FA
- Grid photocoagulation
- Guarded prognosis

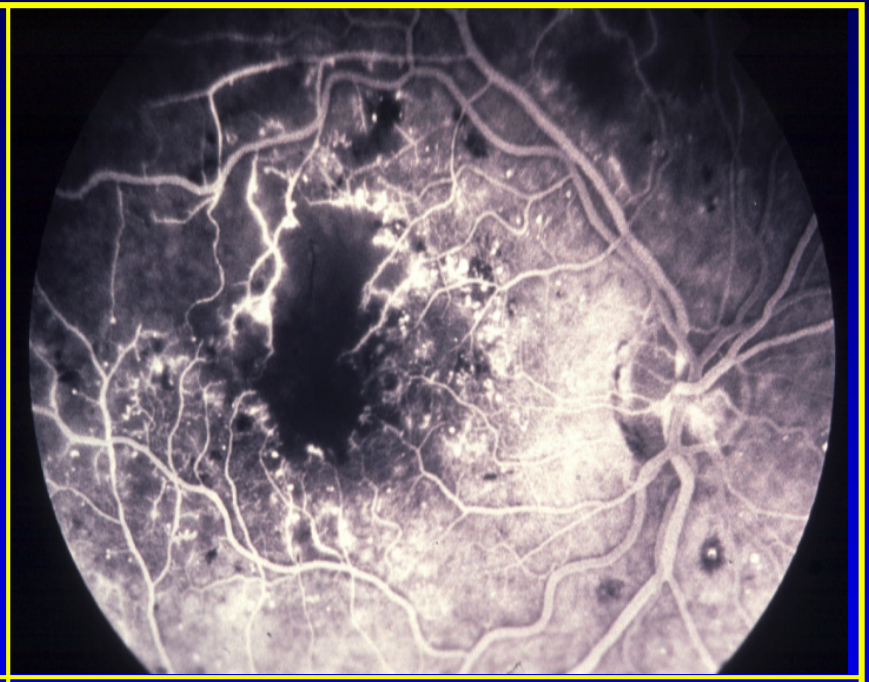
Diabetic maculopathy



Ischemic diabetic maculopathy



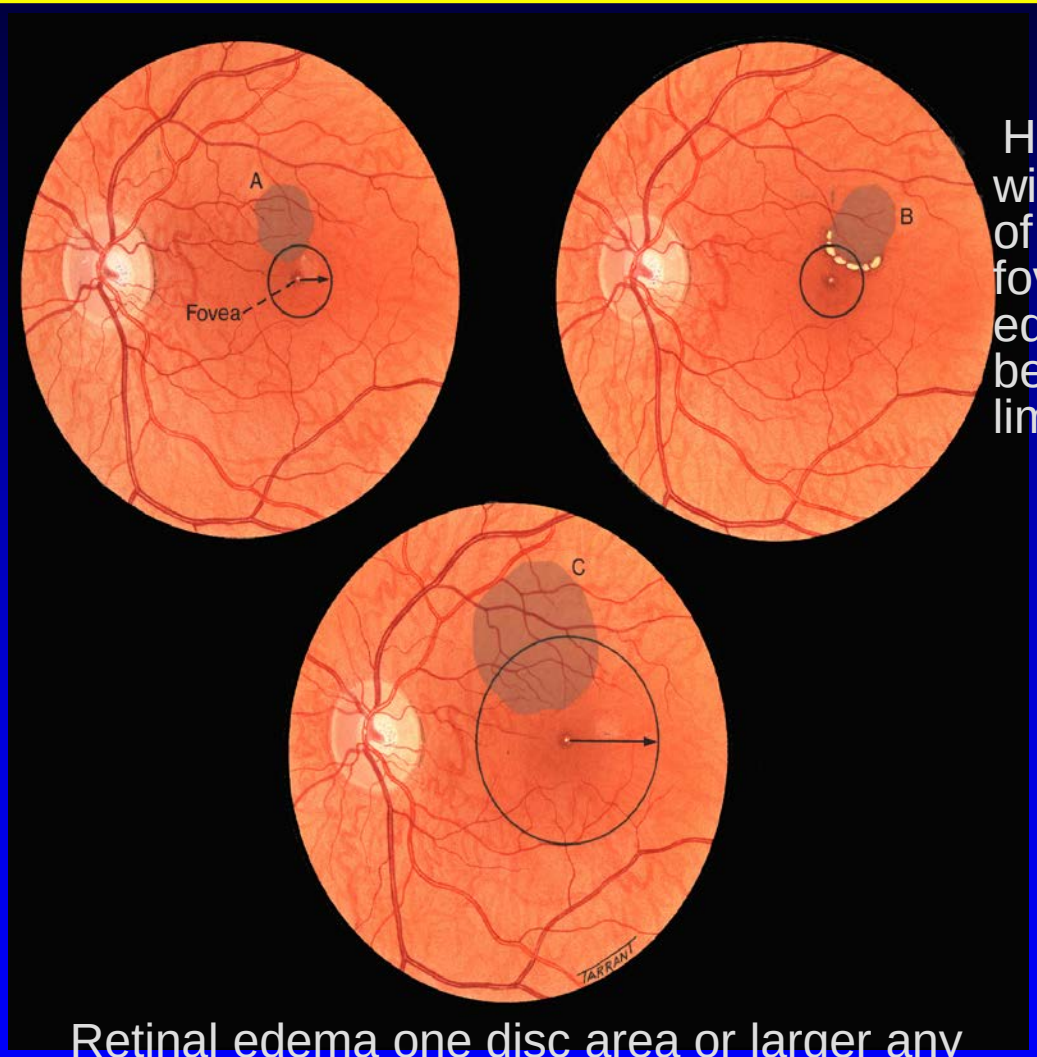
- Macula appears relatively normal
- Poor visual acuity



- Capillary non-perfusion on FA
- Treatment not appropriate

Clinically significant macular edema

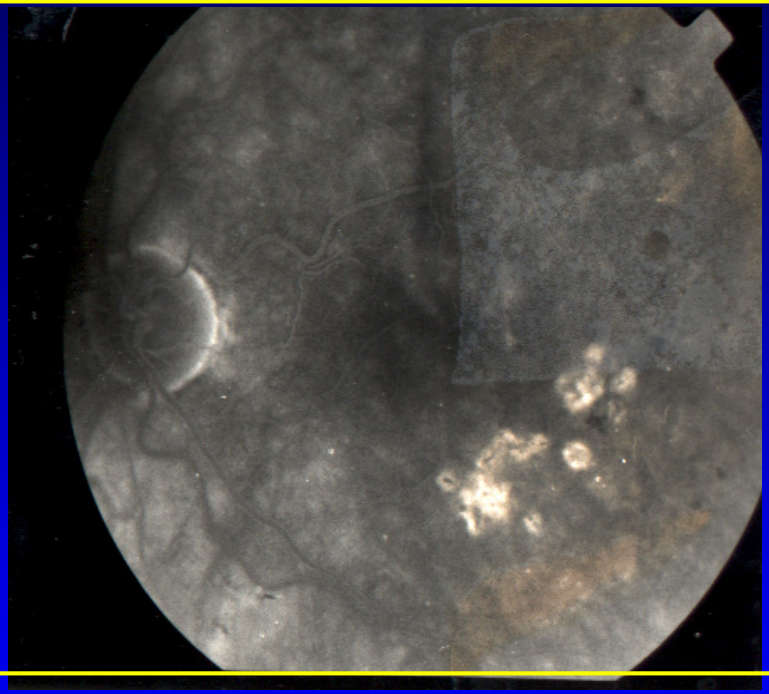
Retinal edema within 500 μm of centre of fovea



Hard exudates within 500 μm of centre of fovea with adjacent edema which may be outside 500 μm limit

Retinal edema one disc area or larger any part of which is within one disc diameter (1500 μm) of centre of fovea

Treatment of clinically significant Macular edema

Grid treatment	Focal treatment
	
• For diffuse retinal thickening located more than 500 μm from center of fovea and 500 μm from temporal margin of disc • Gentle burns (100-200 μm, 0.10 sec), one burn width apart	• For microaneurysms in centre of hard exudate rings located 500-3000 μm from center of fovea • Gentle whitening or darkening of microaneurysm (100-200 μm, 0.10 sec)

Pre-proliferative

Preproliferative diabetic retinopathy

Signs

- Cotton-wool spots
- Venous irregularities

- Dark blot hemorrhages
- Intraretinal microvascular abnormalities (IRMA)

Treatment - not required but watch for proliferative disease

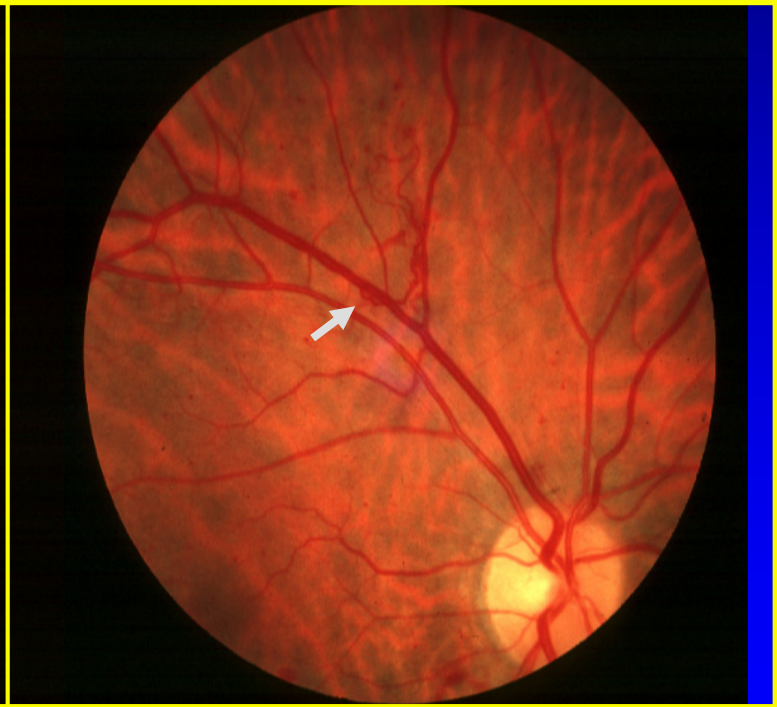
Proliferative diabetic retinopathy

- Affects 5-10% of diabetics
- IDD at increased risk (60% after 30 years)

Neovascularization

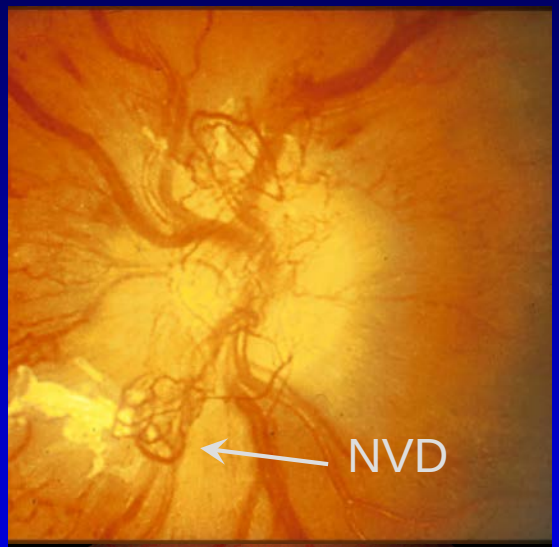
- Flat or elevated
- Severity determined by comparing with area of disc

Neovascularization of disc = NVD

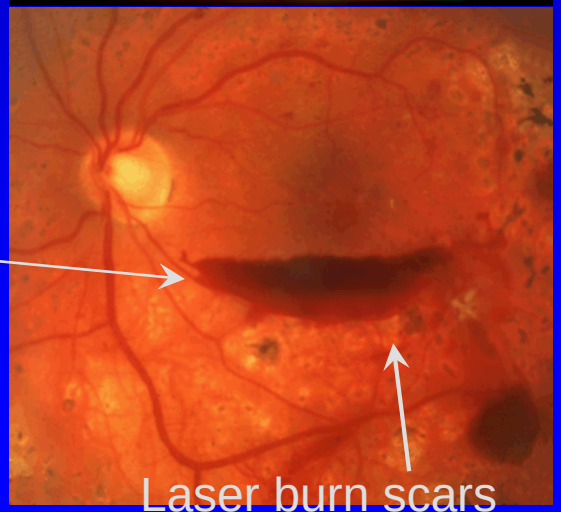


Neovascularization elsewhere = NVE

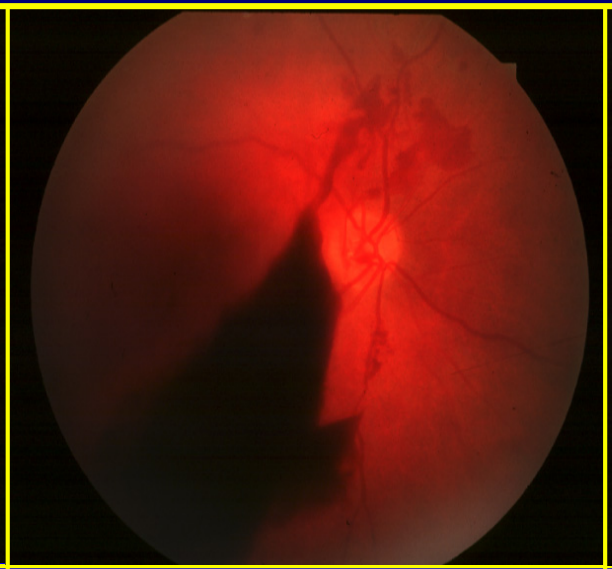
Proliferative retinopathy



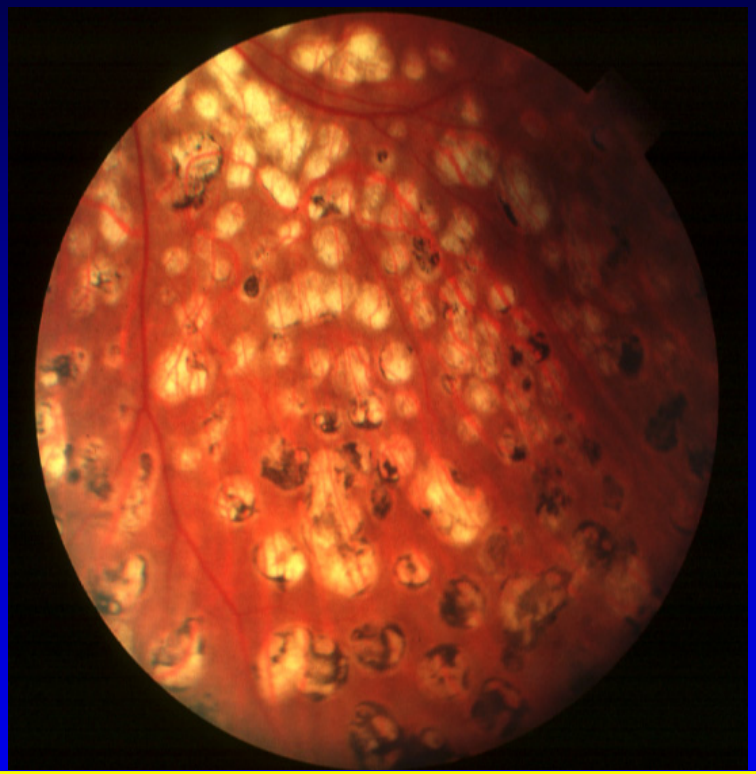
Pre-retinal
haemorrhage

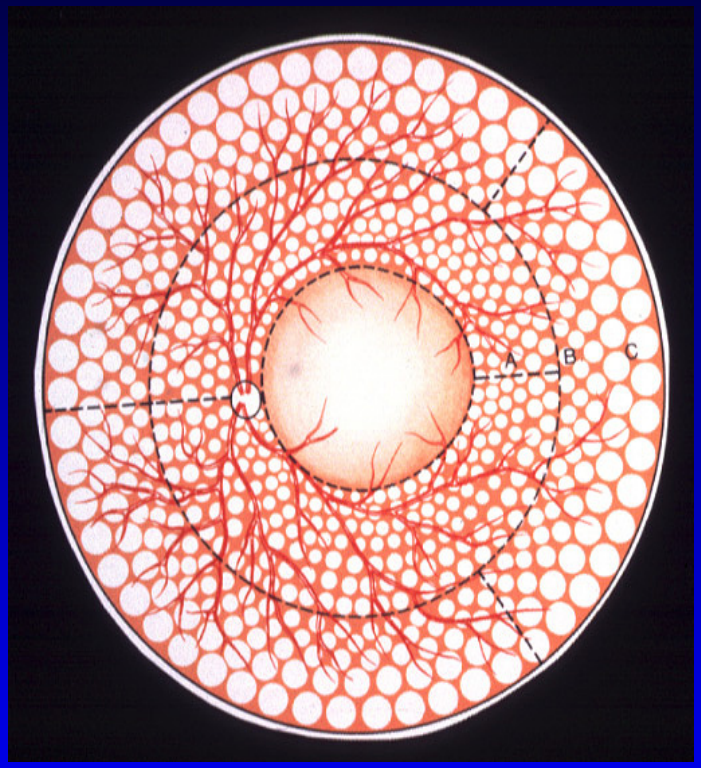


Indications for treatment of proliferative diabetic retinopathy

		
NVD > 1/3 disc in area	Less extensive NVD + haemorrhage	NVE > 1/2 disc in area + haemorrhage

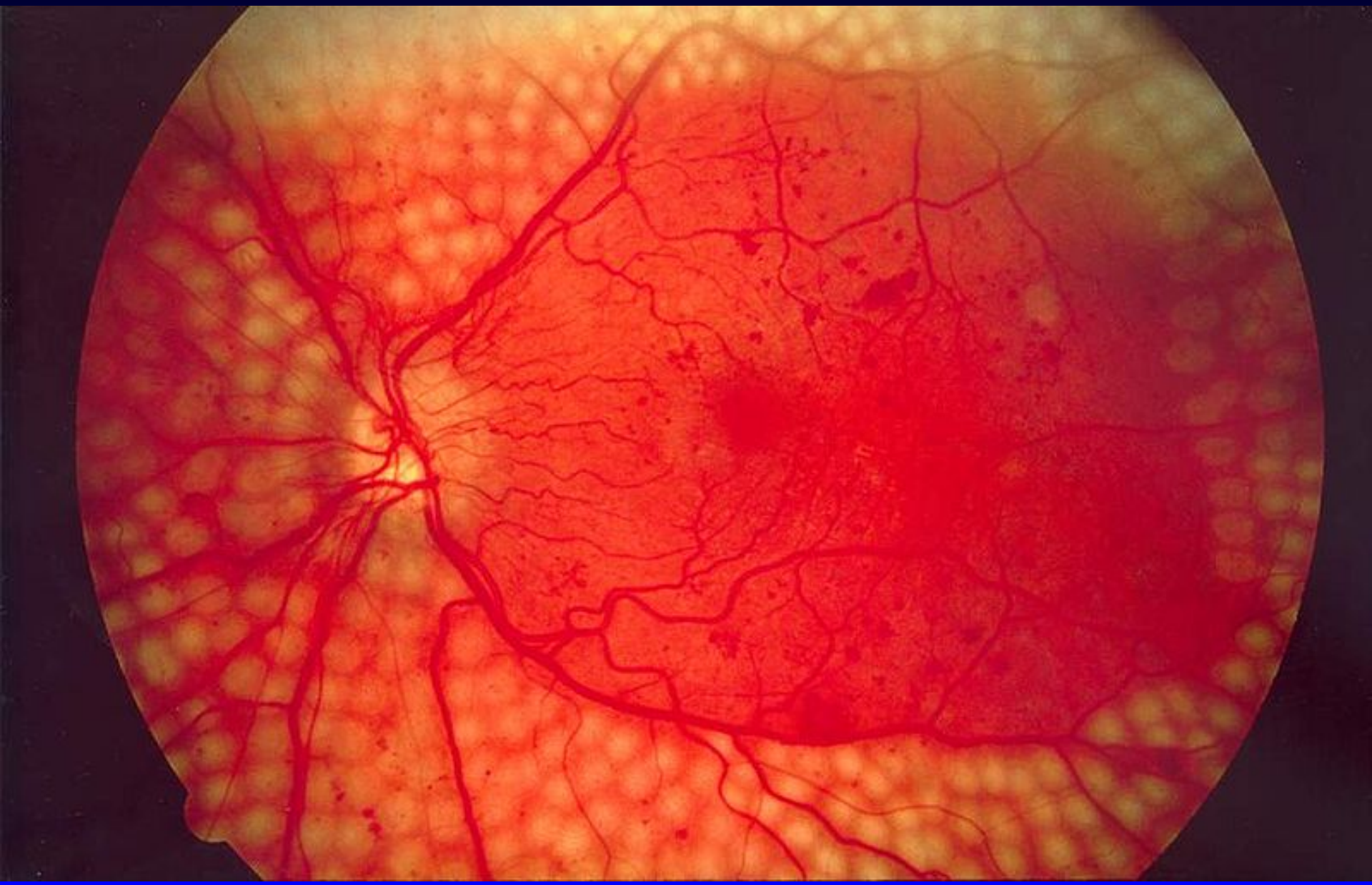
Laser panretinal photocoagulation





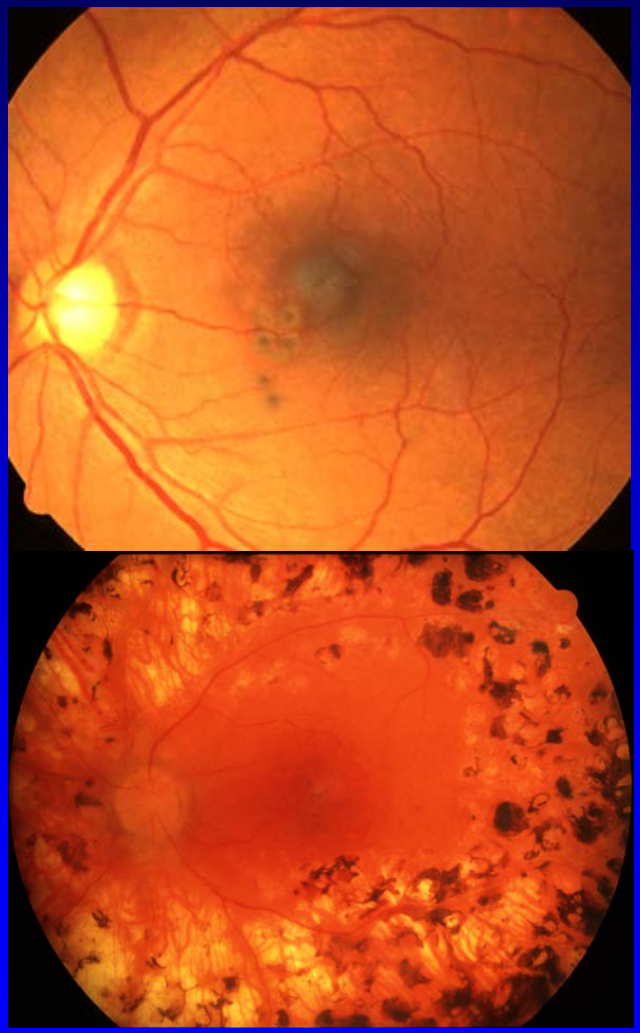
- Initial treatment is 2000-3000 burns
- Spot size (200-500 μm) depends on contact lens magnification
- Gentle intensity burn (0.10-0.05 sec)

- Area covered by complete PRP
- Follow-up 4 to 8 weeks



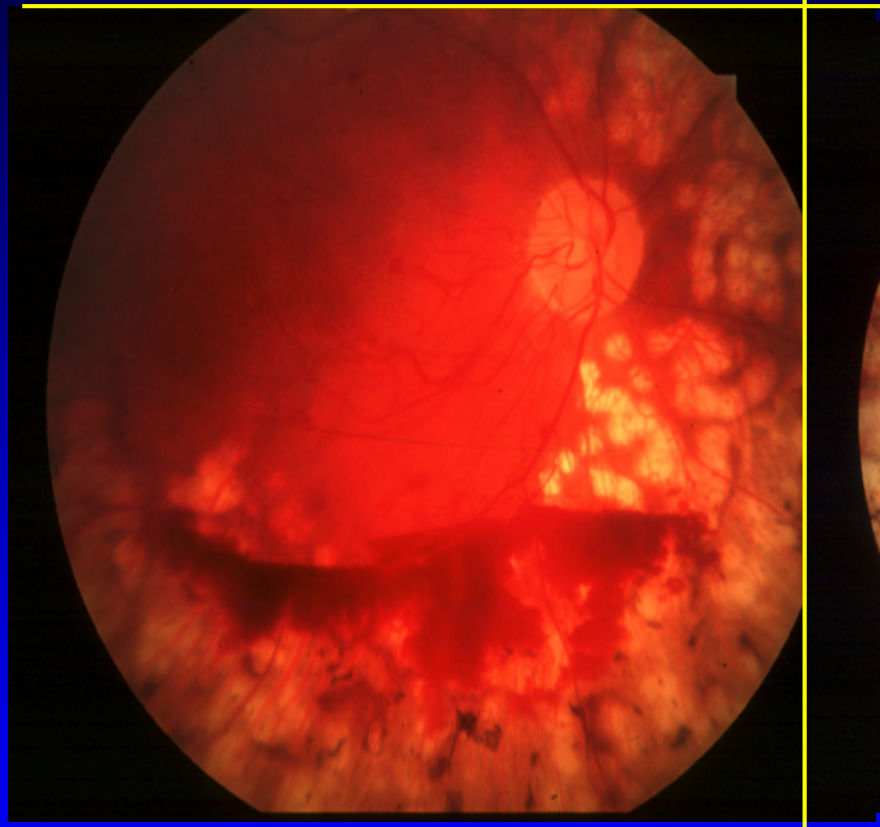
TREATMENT

- **LASER: Light Amplification by the Stimulated Emission of Radiation**
  - **Focal**
  - **Grid**
  - **Panretinal photocoagulation**



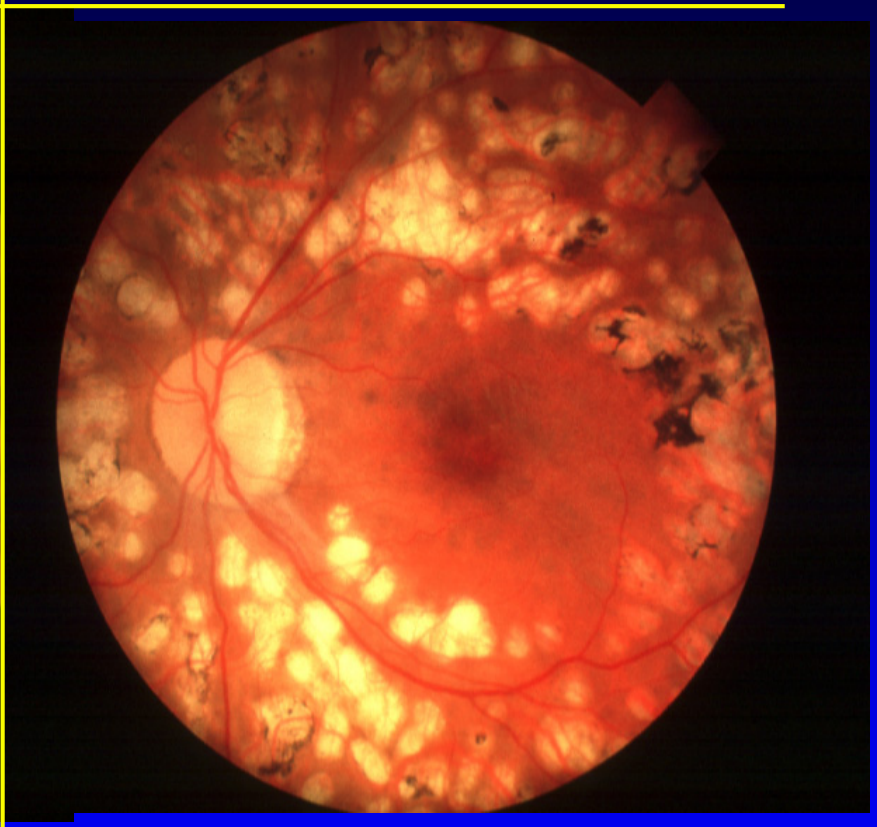
Assessment after photocoagulation

Poor involution



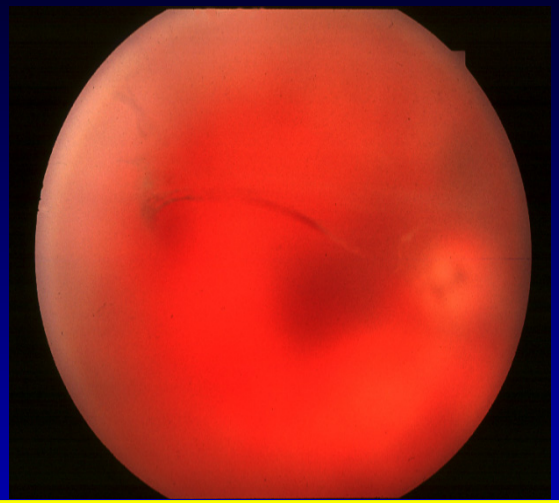
- Persistent neovascularization
- Hemorrhage
- Re-treatment required

Good involution

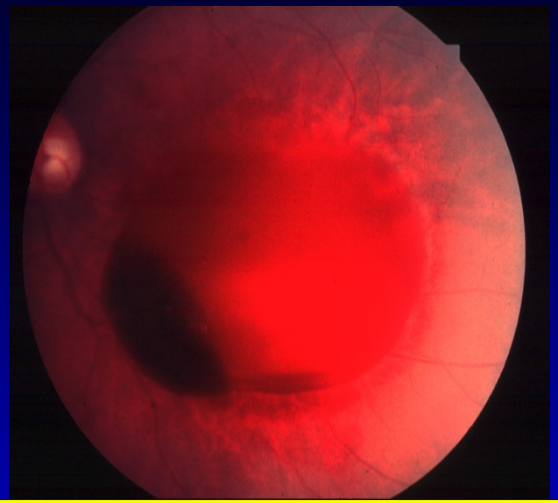


- Regression of neovascularization
- Residual ‘ghost’ vessels or fibrous tissue
- Disc pallor

Indications for vitreoretinal surgery



Severe persistent vitreous hemorrhage

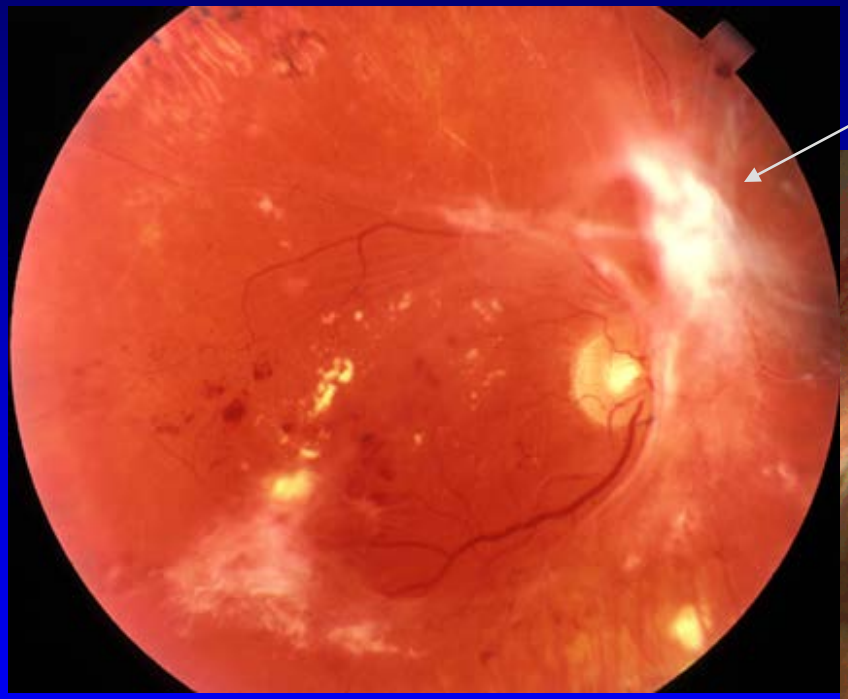


Dense, persistent premacular hemorrhage

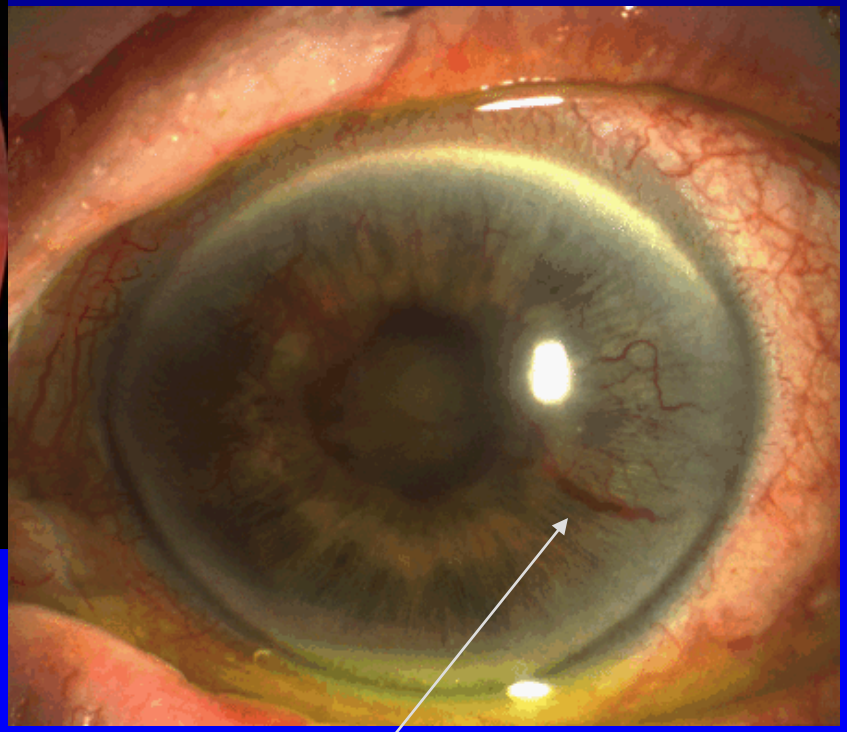
Progressive proliferation despite laser therapy

Retinal detachment involving macula

Advanced diabetic eye disease



Preretinal fibrosis and tractional retinal detachment

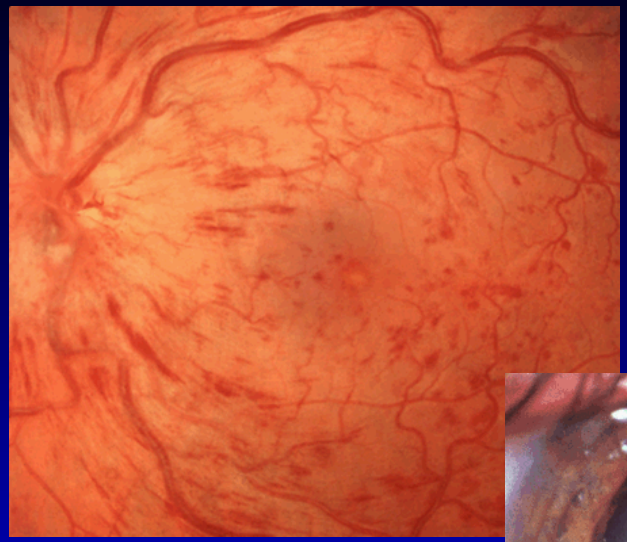


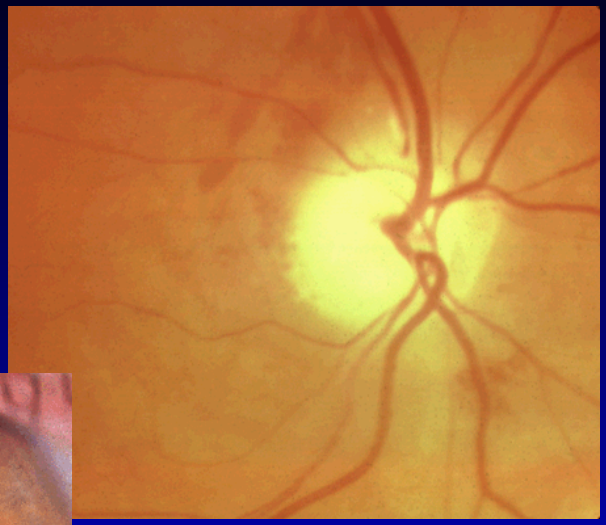
Rubeosis iridis

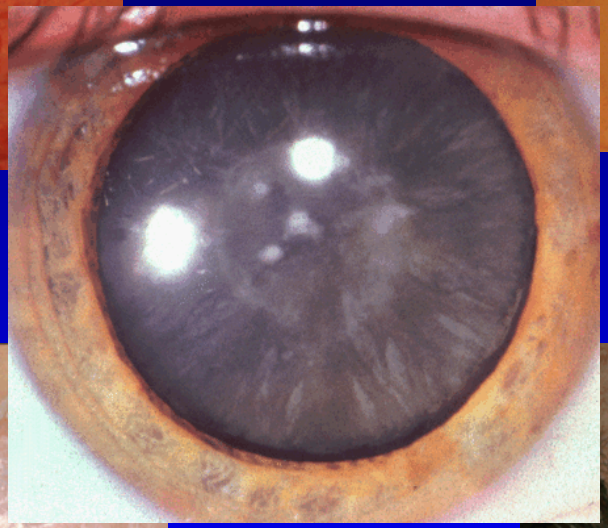
End-stage diabetic eye disease

- **PHTHISIS**

Shrunken, soft eye with opaque vascularised cornea and no visual potential







Overview

- Background Information
- Retinal Vascular Disease
- Age-Related Macular Degeneration
- Diabetic Retinopathy
- Questions from the Audience

References

American Diabetes Association: Retinopathy in Diabetes (Position Statement). *Diabetes Care* 27 (Suppl.1): S84-S87, 2004

Diabetic Retinopathy: What you should know. Bethesda, MD: National
Eye Institute, National Institutes of Health (NIH), DHHS; 2004.

Aiello LP, Gardner TW, King GL, Blankenship G, Cavallerano JD, Ferris FL 3rd, Klein R: Diabetic Retinopathy. *Diabetes Care* 21 (1): 143-156,1998.