EPIRETINAL MEMBRANE & VITREOMACULAR TRACTION

Management of ERM and VMT

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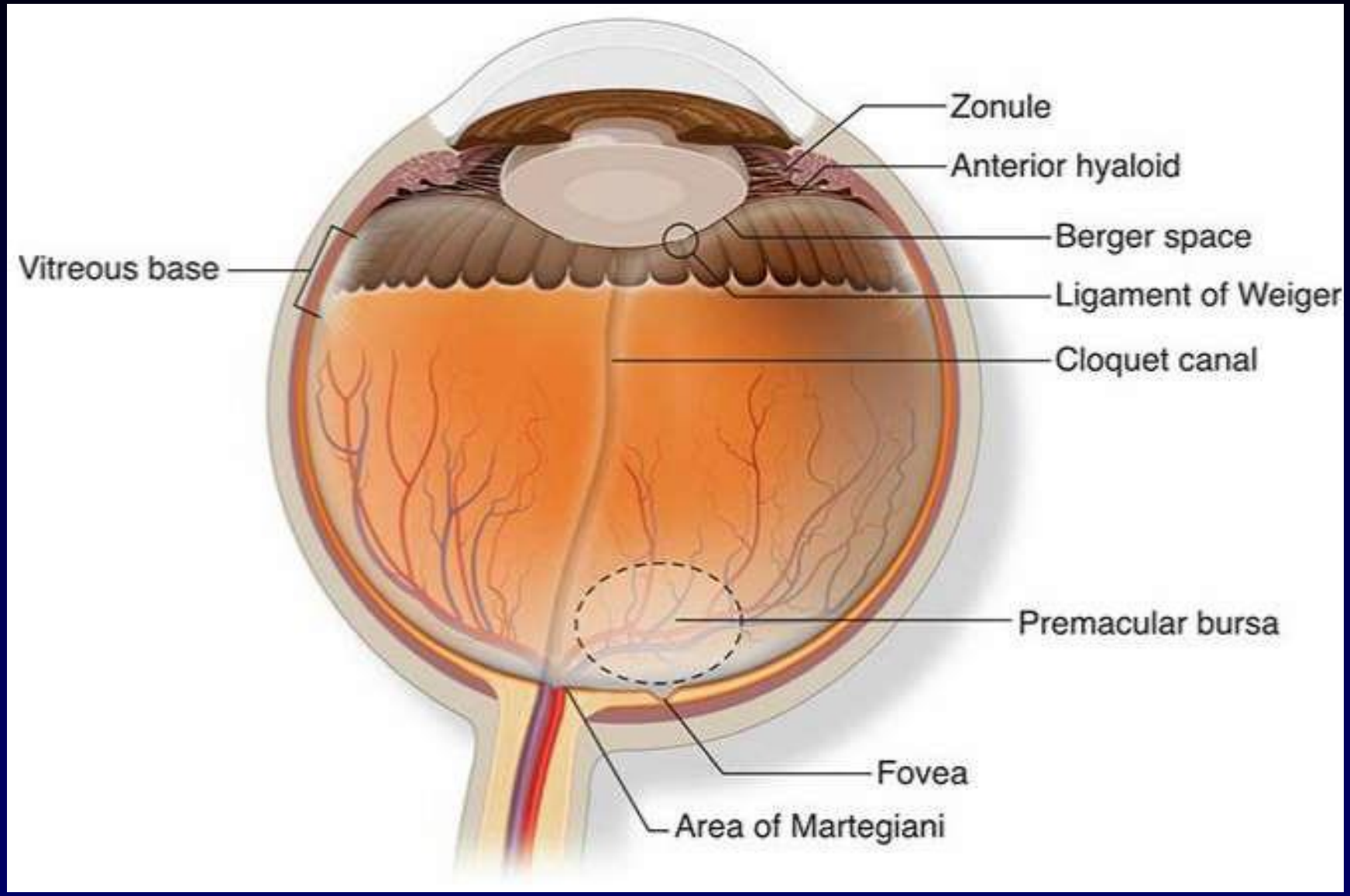
REVIEW
ANATOMY

- The vitreous is a transparent gel composed of water, collagen, and hyaluronic acid
- it **occupies 80%** of the volume of the eye.
- The vitreous body is divided into
  - the central or core
  - the peripheral or cortical


Zonule
Anterior hyaloid
Berger space
Vitreous base
Ligament of Weiger
Cloquet canal
Premacular bursa
Fovea
Area of Martegiani

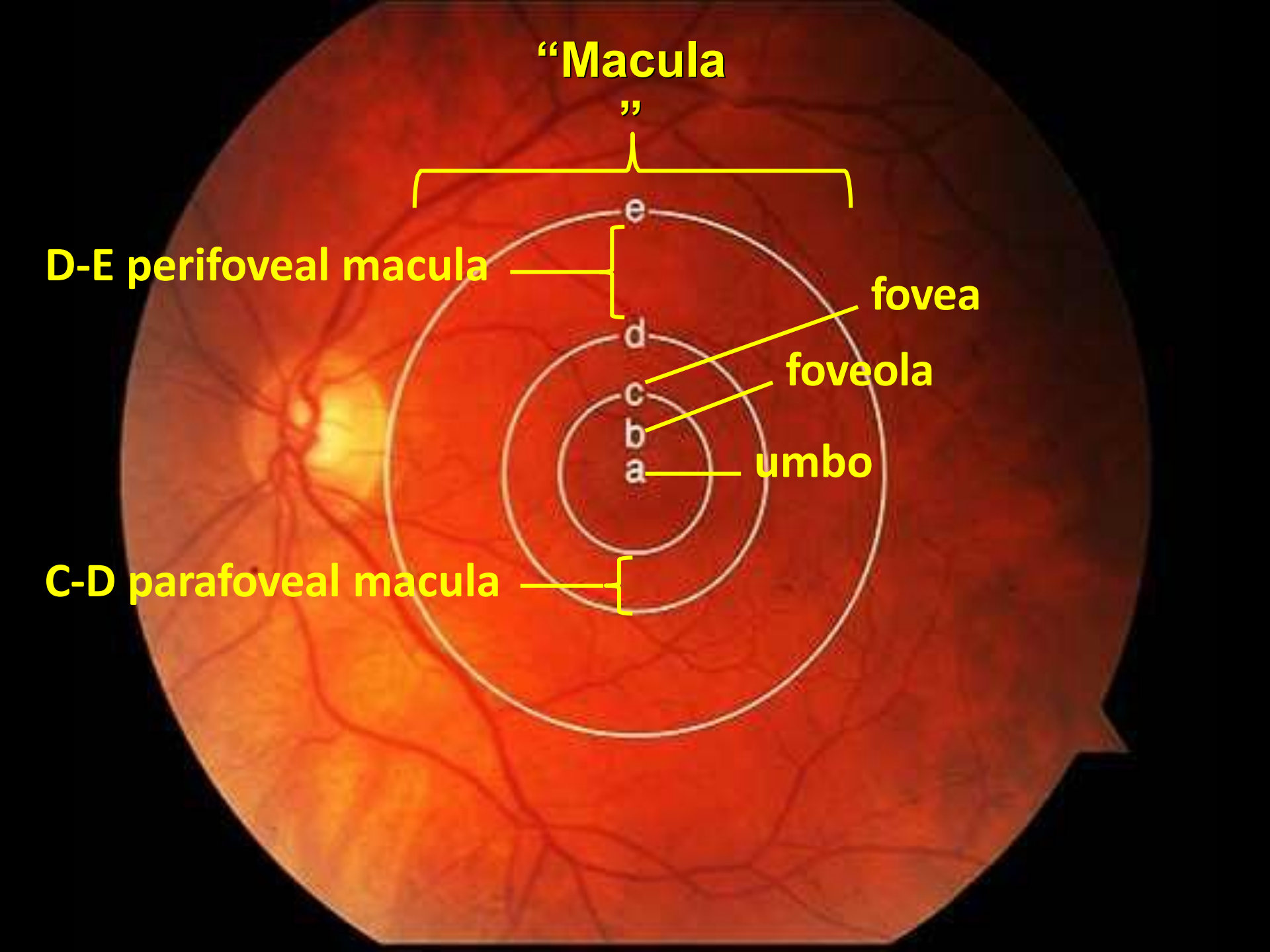
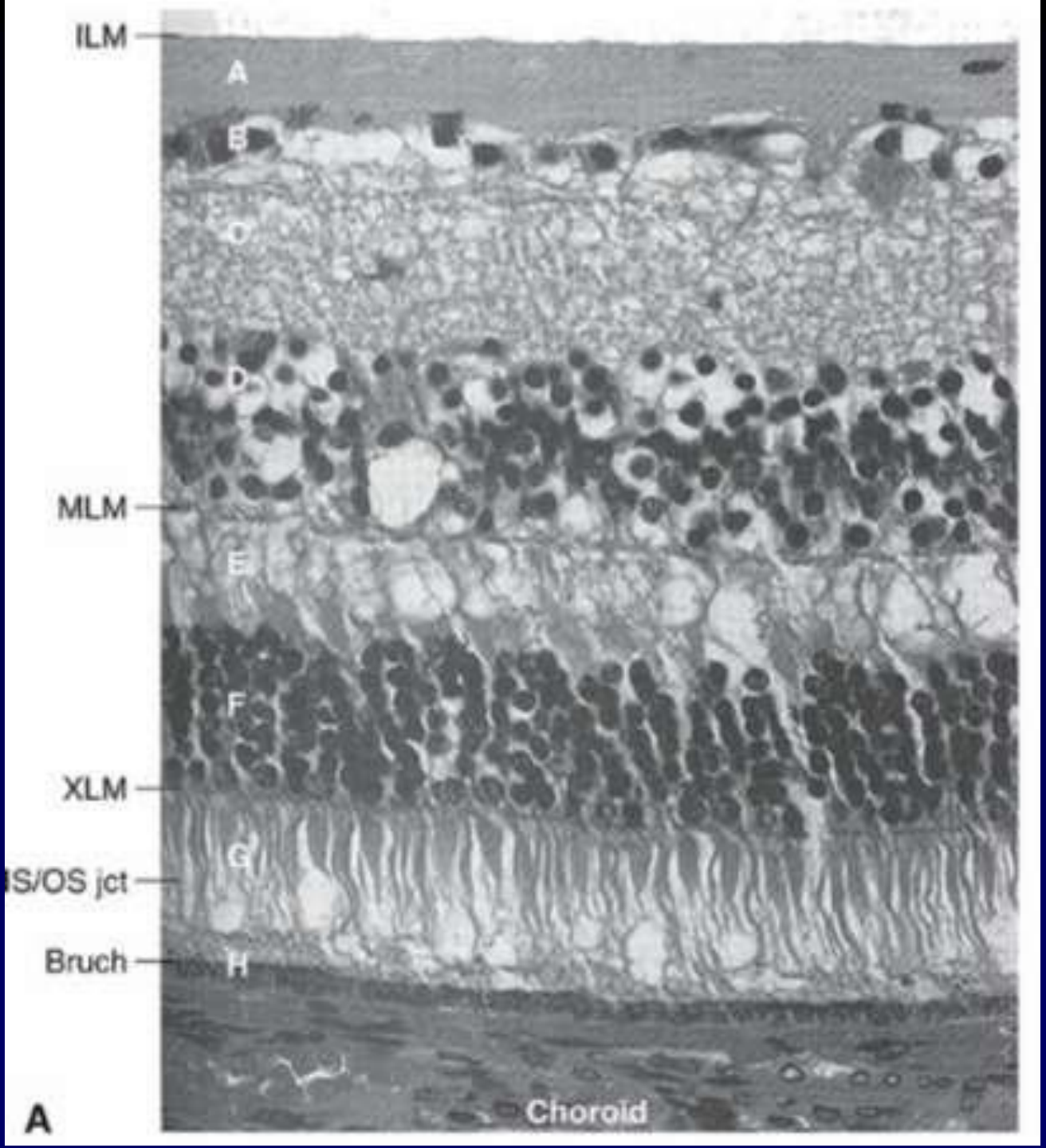

“Macula ”
e
d
c
b
a
D-E perifoveal macula
fovea
foveola
umbo
C-D parafoveal macula

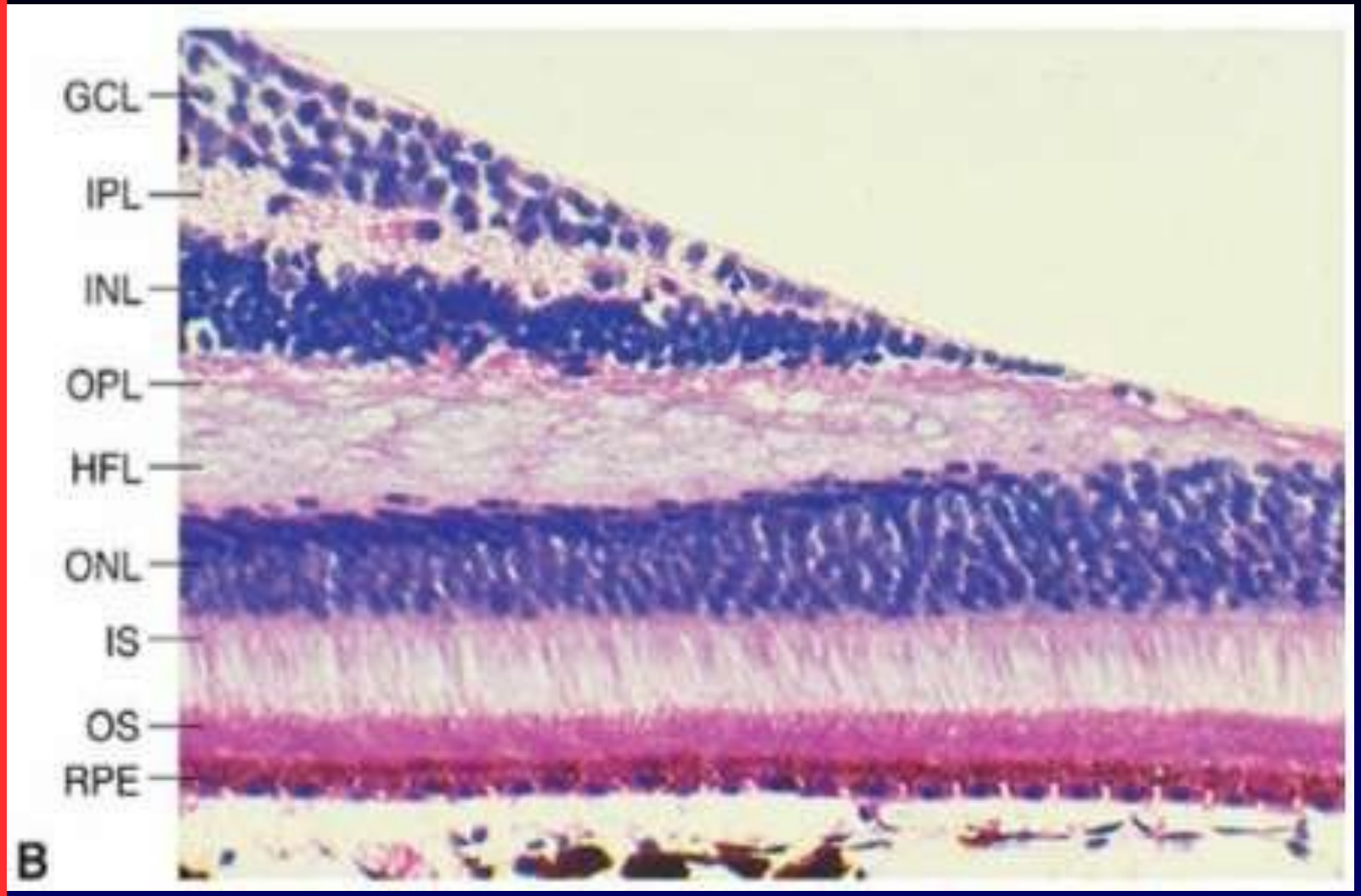
Table 1-1 Anatomical Terminology of the Macula (Area Centralis)

Term	Synonym	Histologic Definition	Clinical Observation and Size
Macula	Posterior pole Area centralis	Contains 2 or more ganglion cell layers	Area between vascular arcades 5.5 mm in diameter centered 3.0 mm temporal and 0.8 mm inferior to the center of the optic disc
Perifovea		From the outermost limit of the parafovea to the outer limit of the macula	Ring 1.5 mm in width surrounding the parafovea
Parafovea		Margin, where the ganglion cell layer, inner nuclear layer, and Henle layer are thickest (ie, the retina is thickest)	Ring 0.5 mm in width surrounding the fovea
Fovea	Fovea centralis	A depression in the inner retina; has a margin, slope, and floor, the photoreceptor layer of which is entirely cones	A concave central retinal depression seen on slit-lamp examination 1.5 mm in diameter (about 1 disc diameter, or 5°)
Foveola		The floor of the fovea features cones only, arranged in the shape of a cake (gâteau nucléaire), where the inner nuclear layer and ganglion cell layer are laterally displaced	0.35 mm in diameter, usually smaller than the foveal avascular zone
Umbo	Fixation Light reflex	Small (150–200 μm) center of the floor of the foveola; features elongated cones forming a bouquet of cones	Observed point corresponding to the normal light reflex but not solely responsible for this light reflex

RETINAL IN LAYERS



RETINAL IN LAYERS



EPIRETINAL MEMBRANE

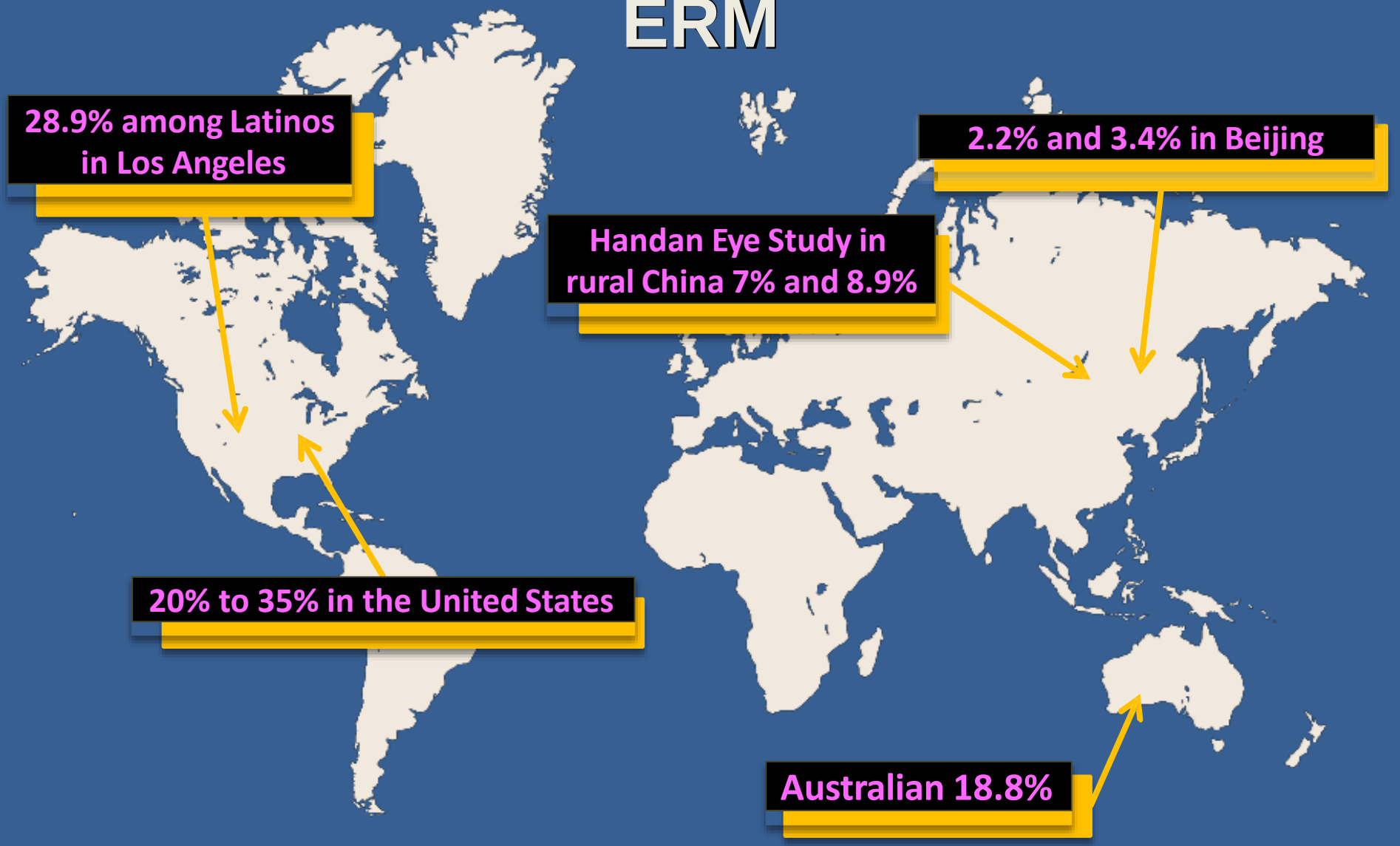
DEFINITION

Epiretinal membranes (ERMs) are sheet-like structures that develop on the inner surface of the neurosensory retina.

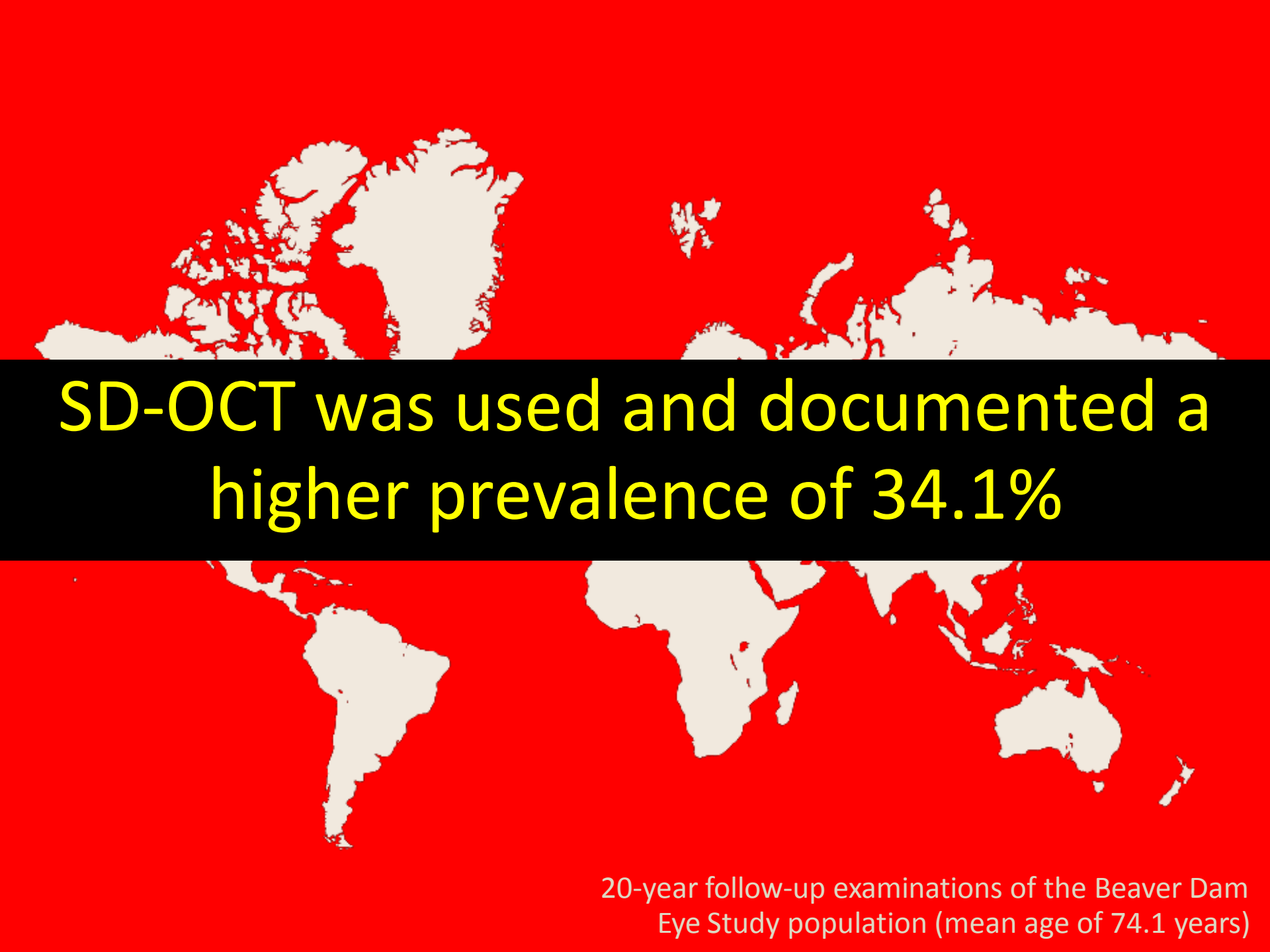
The macular changes that result from either ERM or VMT lead to similar symptoms: reduced visual acuity, metamorphopsia, difficulty using both eyes together, and even diplopia

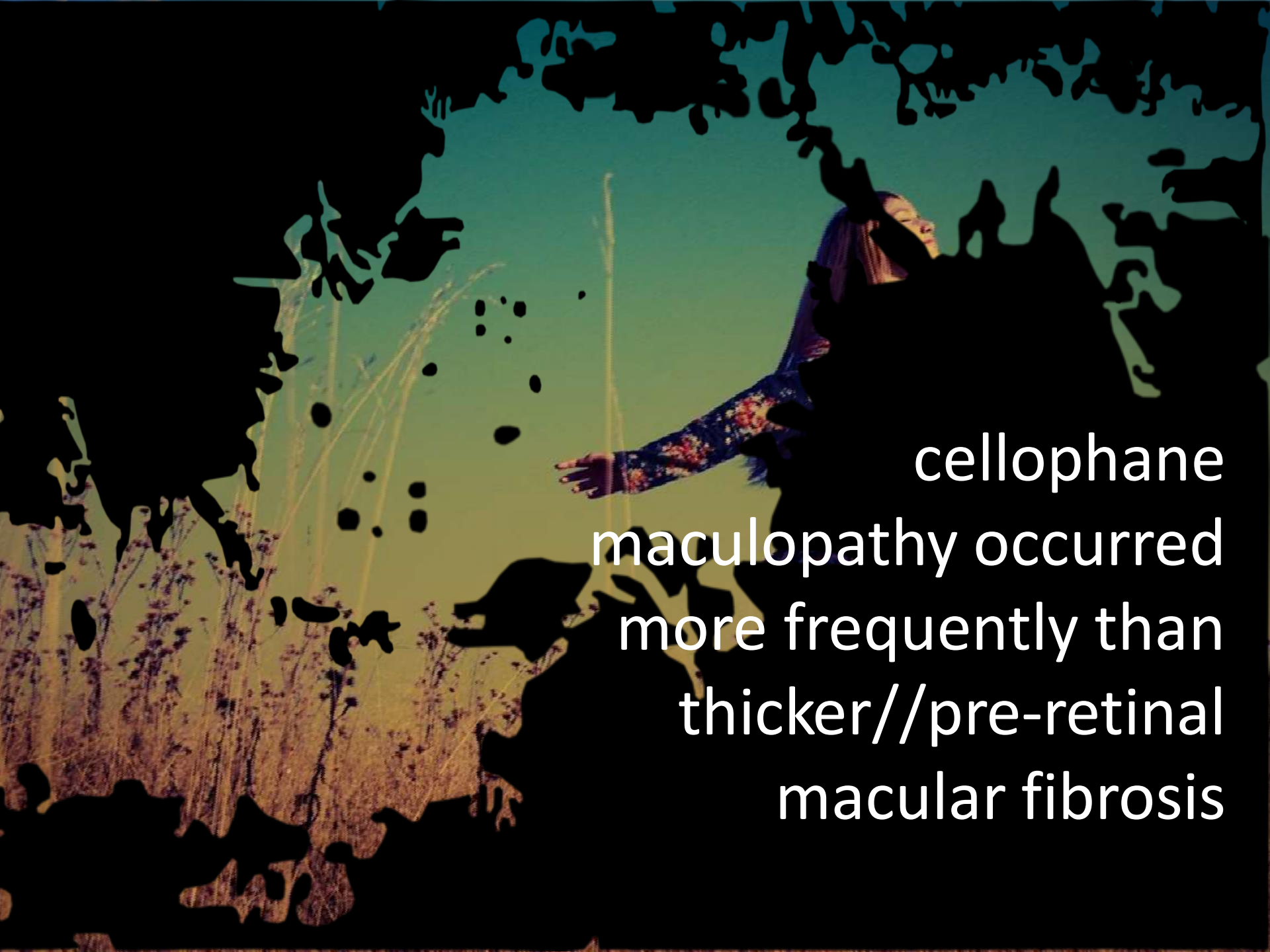
- The patient population is predominately adults.
- **Idiopathic ERM** →No identifiable cause
- **Secondary ERM**→after retinal breaks, tears or detachments, post-intraocular surgery, trauma, intraocular Laser →proliferation of RPE or glial cells
- More common in DR, CRVO, BRVO

The prevalence of Idiopathic ERM

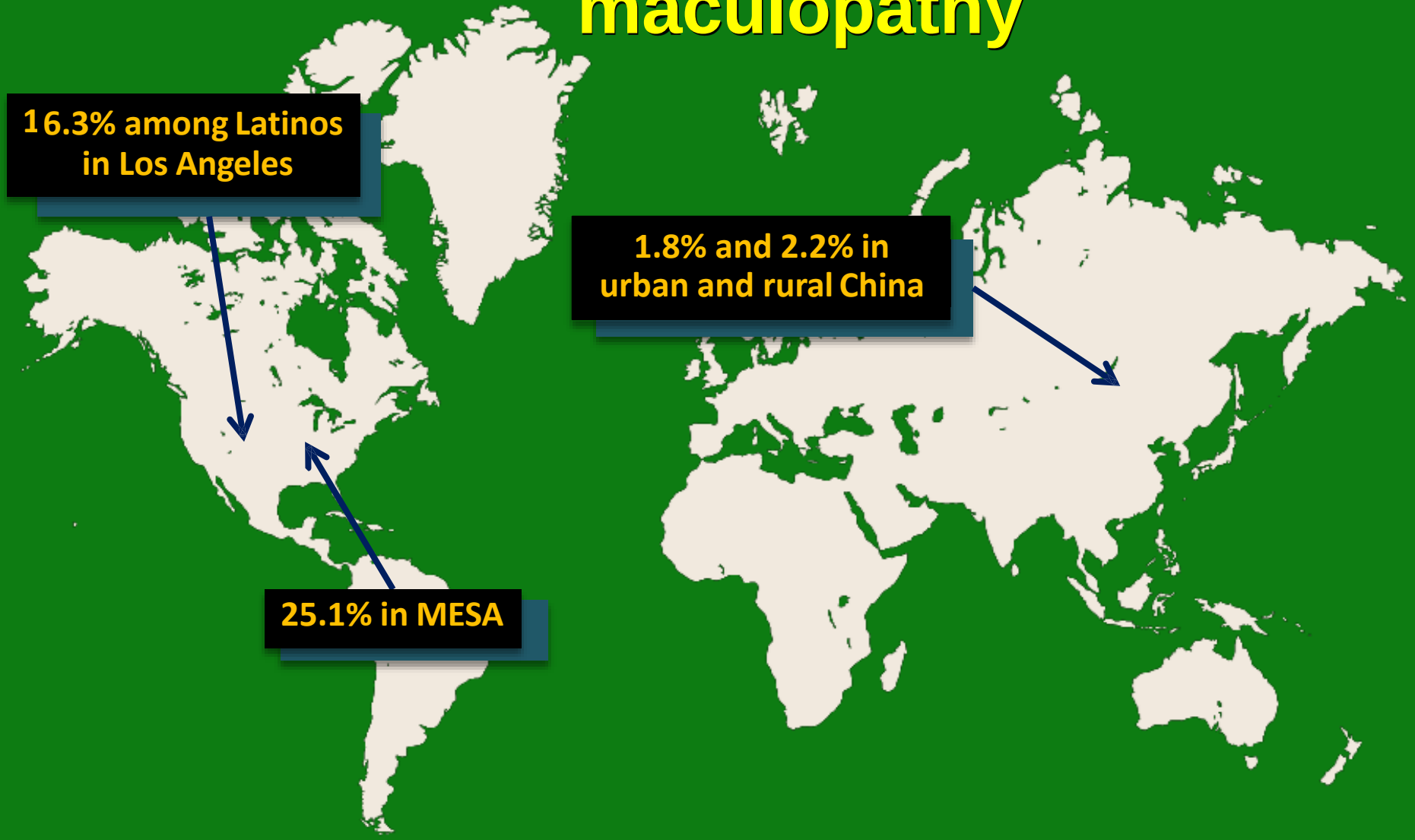


multi-ethnic study conducted in six communities in the United States (Multi-Ethnic Study of Atherosclerosis [MESA])


SD-OCT was used and documented a higher prevalence of 34.1%
20-year follow-up examinations of the Beaver Dam Eye Study population (mean age of 74.1 years)

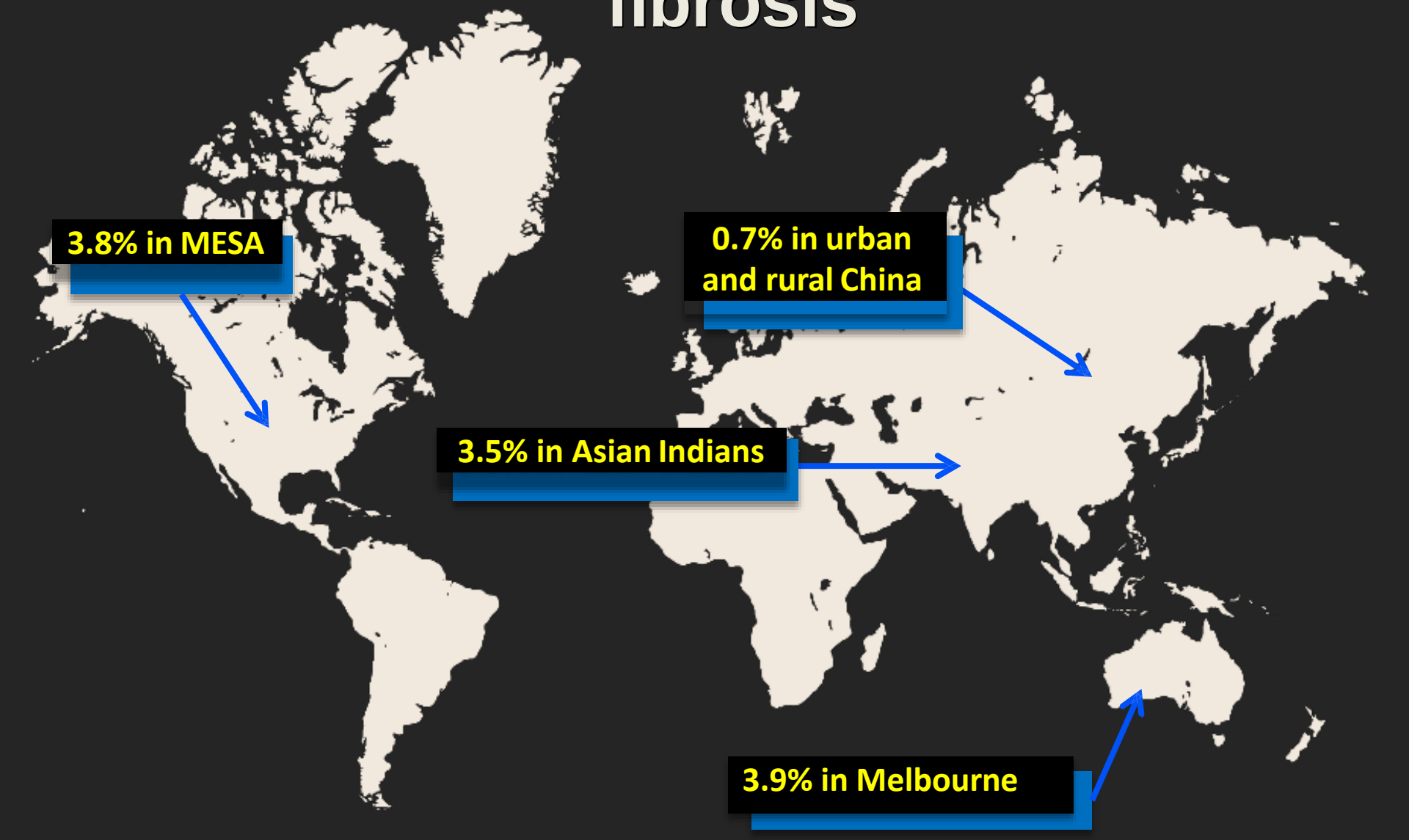

cellophane
maculopathy occurred
more frequently than
thicker//pre-retinal
macular fibrosis

The prevalence of cellophane maculopathy



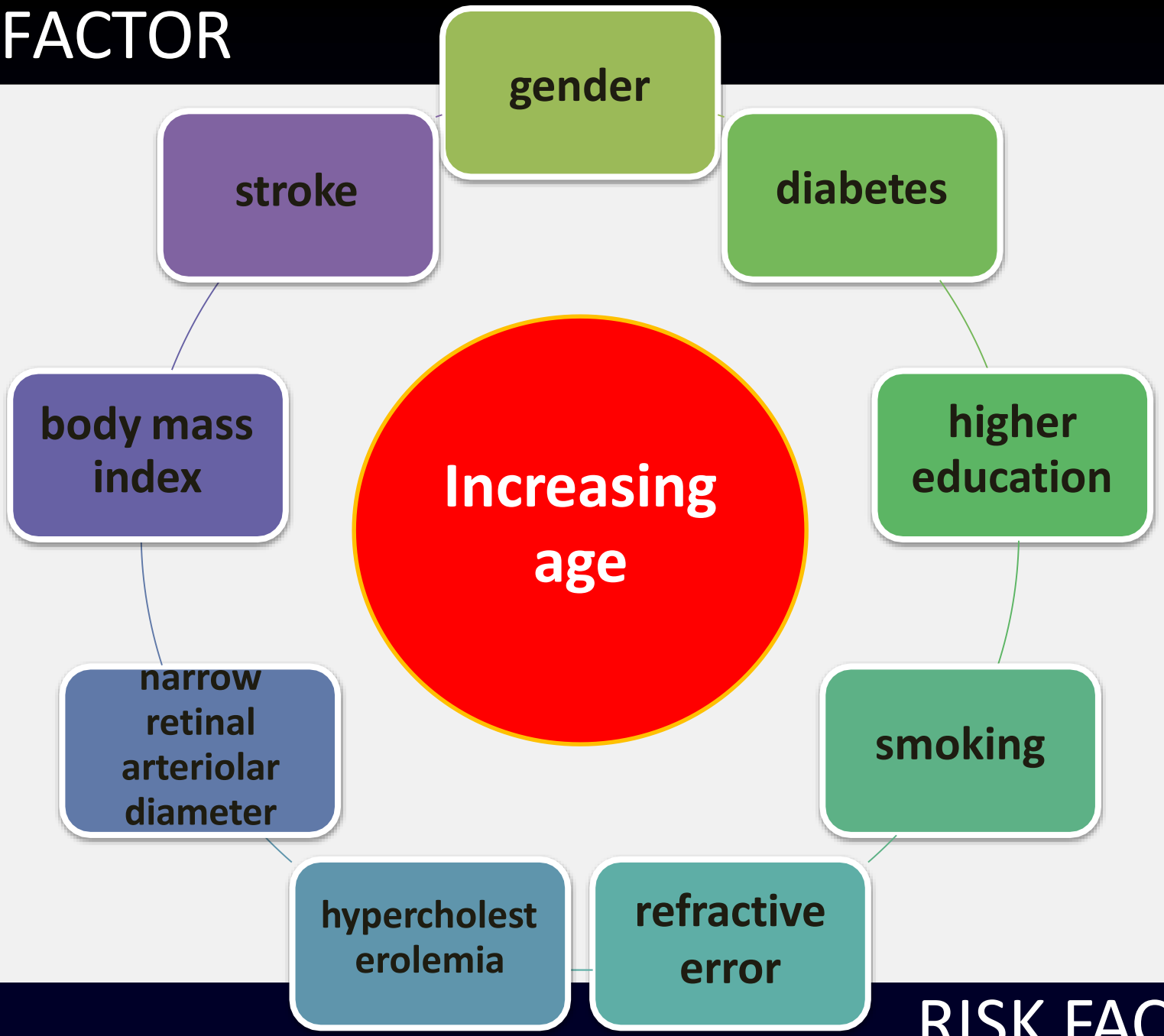
multi-ethnic study conducted in six communities in the United States (Multi-Ethnic Study of Atherosclerosis [MESA])

The prevalence of Pre-retinal macular fibrosis



multi-ethnic study conducted in six communities in the United States (Multi-Ethnic Study of Atherosclerosis [MESA])

RISK FACTOR



RISK FACTOR

prevalence of any ERM was highest in persons of Chinese ancestry (39.0%), intermediate in Hispanics (29.3%) and whites (27.5%), and lowest in blacks (26.2%),

pathogenesis

- ERMs have a variety of possible origins and causes.

- A longstanding hypothesis was that ERMs develop when a PVD results in microbreaks of the ILM that allow for the migration of retinal glial or RPE cells onto the anterior retinal surface, where they proliferate

pathogenesis

- Laminocytes, vitreous cells from the posterior hyaloid membrane (hyalocytes), have been shown to represent a major cellular component of idiopathic ERMs

- Retinal glial cells, hyalocytes transdifferentiate into fibroblasts and myofibroblasts, along with the development of extracellular matrix and fibrosis, together lead to ERM formation.

PATIENT OUTCOME CRITERIA

- Prevent vision loss and functional impairment
- Optimize visual function
- Minimize metamorphopsia and/or diplopia
- Maintain or improve quality of life

SYMPTOMS

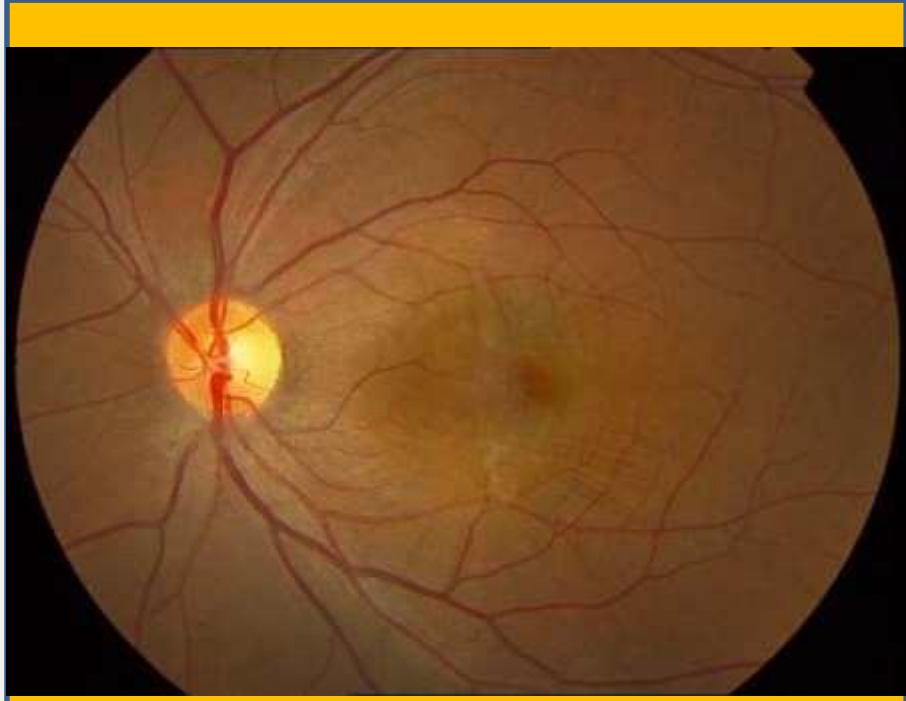
Asymptomatic > Symptomatic > Progressive loss of Visual Function

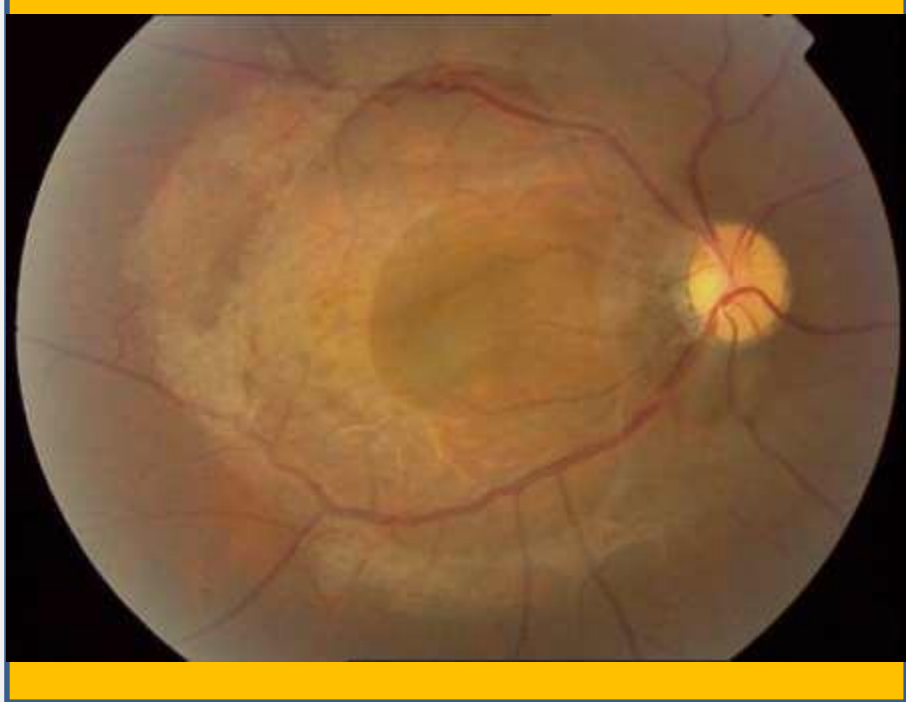
- Metamorphopsia
- Diplopia
- Difficulties in reading, driving,
- Unable to use their eyes together
- VA in ERM or VMT does not change dramatically in short-term follow up

Diagnosis

- The most common type of ERM appears as a thin, translucent cellophane-like membrane on the surface of the retina

- Epiretinal membranes can contract, leading to folds in the retina, distortion of the inner and even the outer macula, traction on retinal vessels, and even displacement of the macula or ectopia





Diagnosis

- The normal foveal depression is often absent and the macula may develop cystoid spaces, lamellar macular hole, or even a full thickness hole.

- Epiretinal membranes that have a thicker, white, fibrotic appearance that obscures the underlying retina, are more likely to become symptomatic and displace the macula than the thinner, more translucent ERMs

Diagnostic tests

- Spectral domain OCT is a highly sensitive and routine method used to diagnose and characterize VMA, ERM, VMT
  - *(III, good quality, strong recommendation)*
- very helpful educational tool to help patients better understand their eye problem

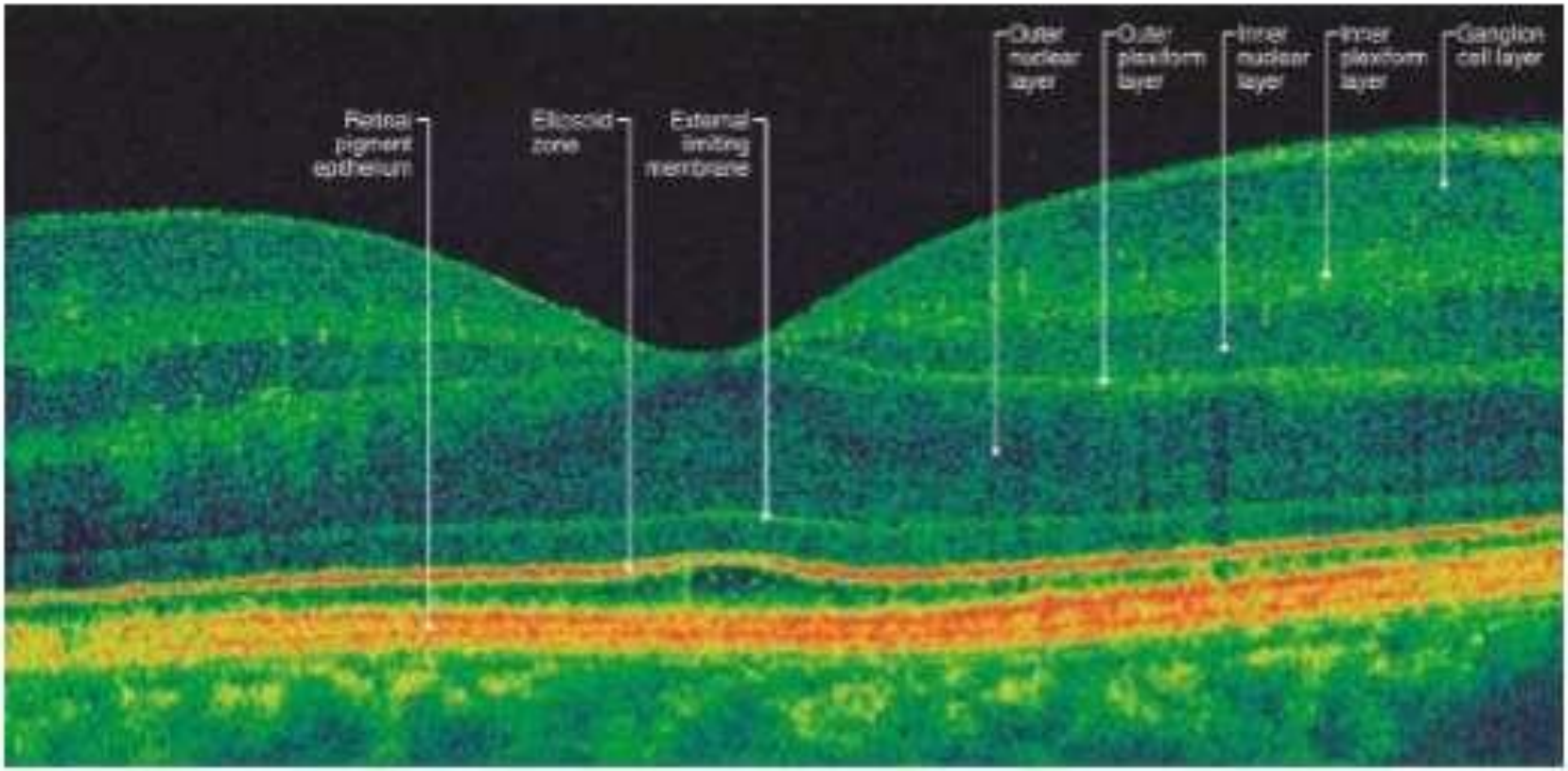
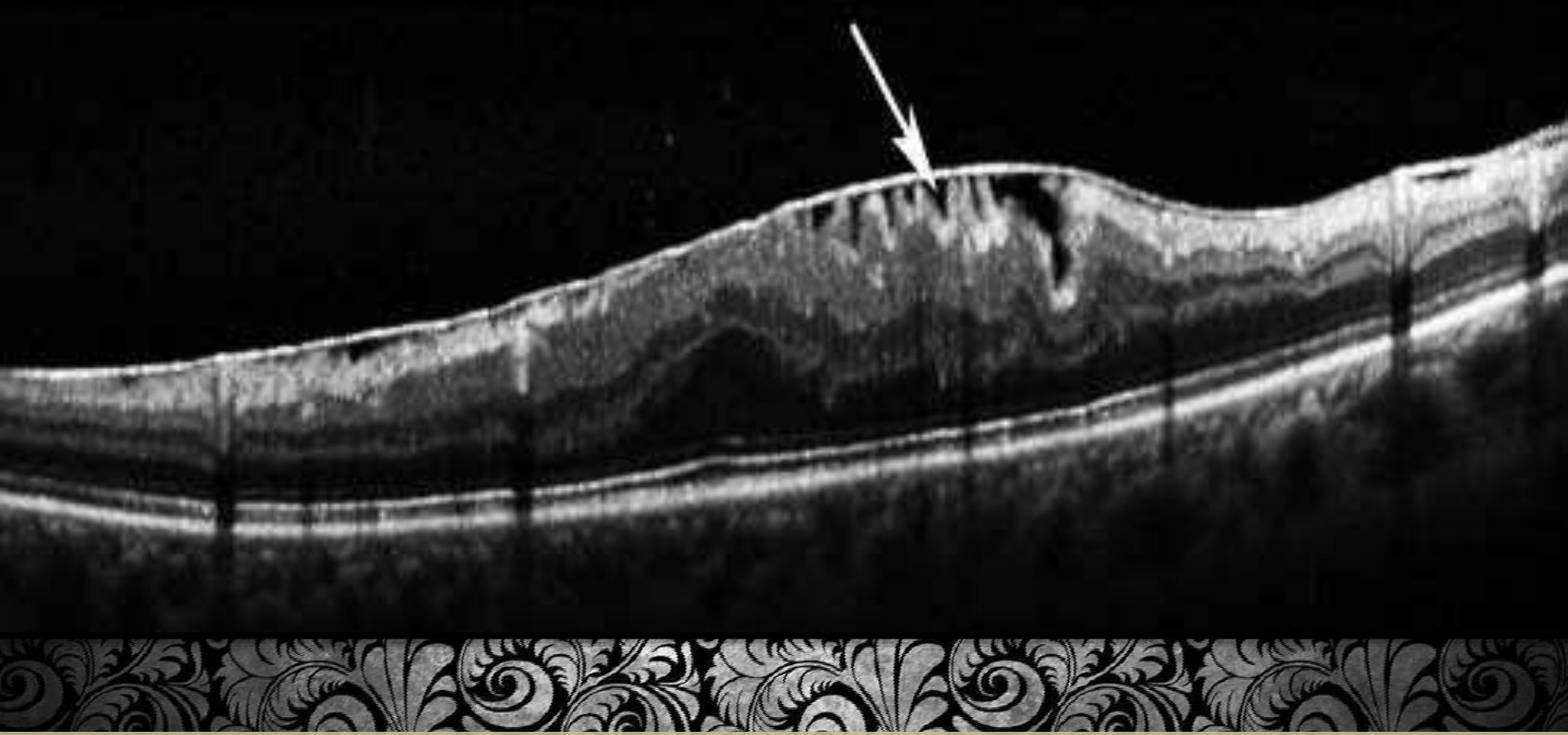


FIGURE 3. Normal retina. The various layers of the retina are easily visualized using spectral domain optical coherence tomography (SD-OCT) imaging through the fovea. (Copyright © 2015 American Academy of Ophthalmology®)



- **A**n ERM on OCT appears as **a hyper-reflective** layer on the inner surface of the retina , usually adherent across the surface of the retina.
- **T**he inner retina is typically thrown into folds, with thickening of the macula and associated **cystoid spaces** in various retinal layers

Traction from the ERM leads to elevation of the normal foveal depression

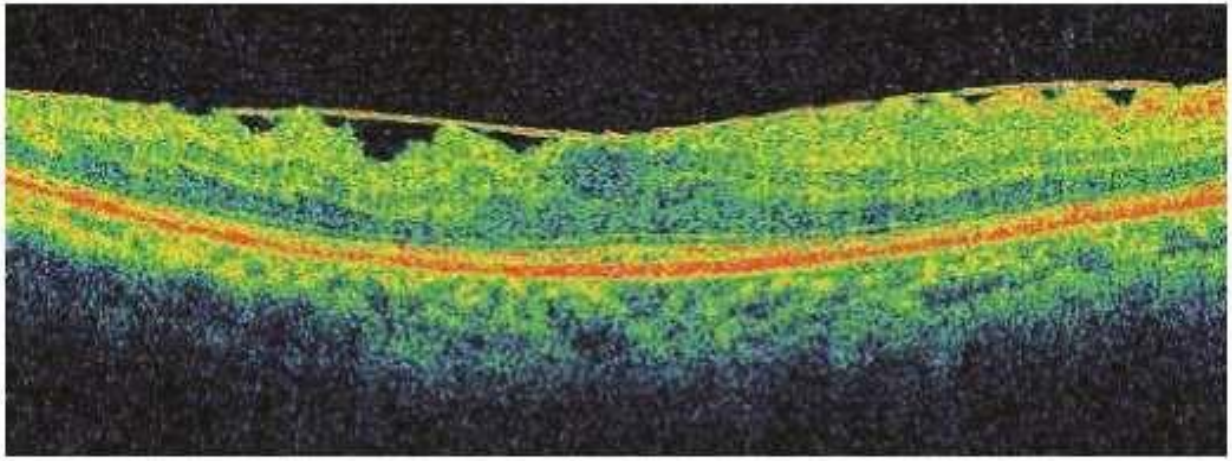


FIGURE 4. Epiretinal membrane. Optical coherence tomography reveals a fine, moderately reflective membrane variably attached to the inner retinal surface. There is associated retinal edema. (Copyright © 2015 American Academy of Ophthalmology®)

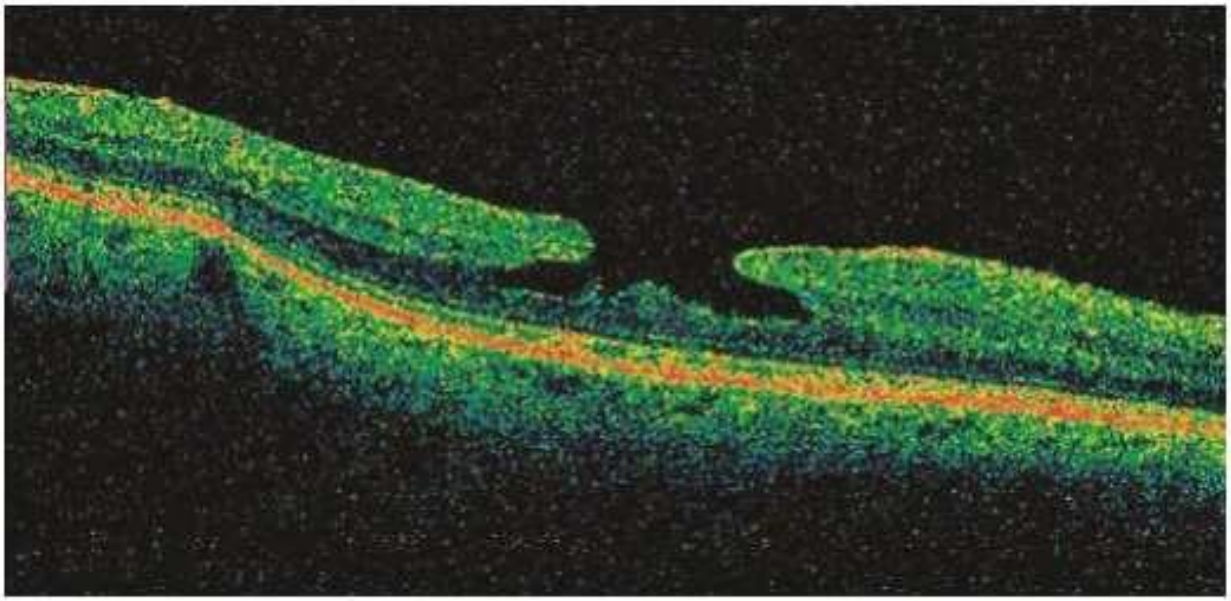
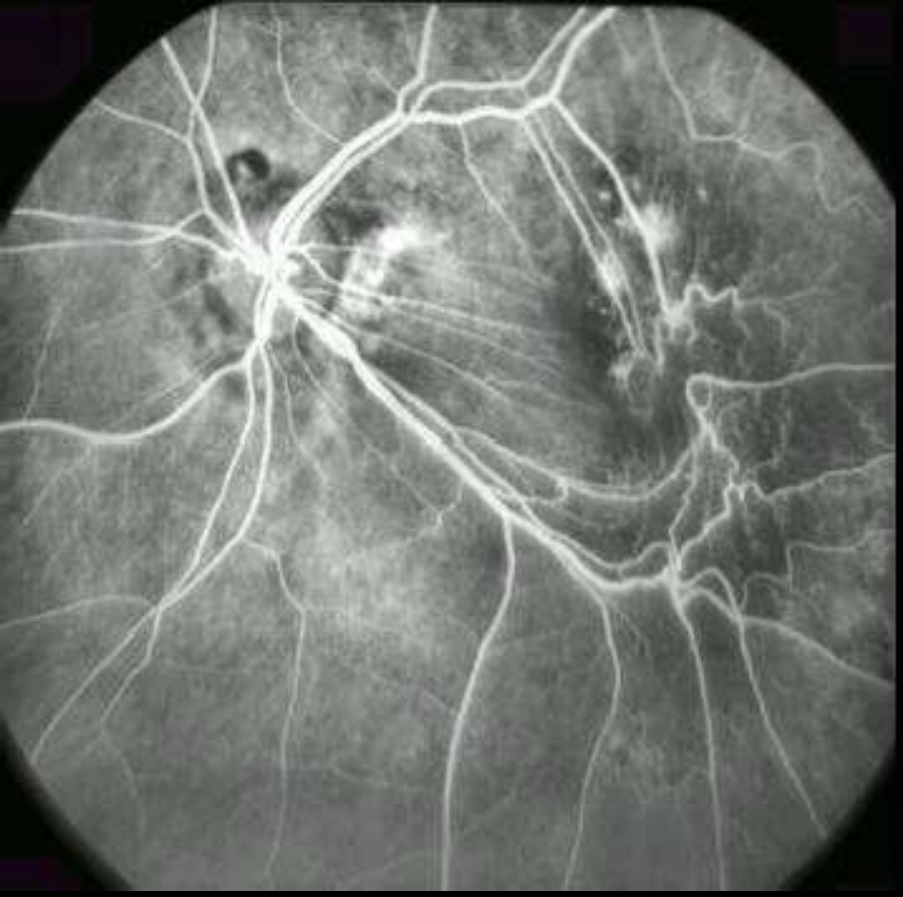


FIGURE 5. Lamellar hole. Optical coherence tomography demonstrates an intraretinal split, with separation of the inner and outer foveal retinal layers and the absence of a full-thickness foveal defect. (Copyright © 2015 American Academy of Ophthalmology®)



- **A** fluorescein angiogram (FA) may be helpful to evaluate ERMs and/or VMT. (and associated abnormality)
- **T**he FA may be relatively normal in eyes with early ERM. As ERM contraction increases, the macular vessels may become tortuous near the epicenter of traction or straightened around the epicenter of traction.

management

- Patients should be **informed** that the majority of ERMs will remain relatively stable and do not require therapy *(good quality, strong recommendation)*
- reassure that there is a very successful surgical procedure. *(good quality, strong recommendation)*
- Educating patients about the signs and symptoms of progression and regular monocular **Amsler grid** testing are both important

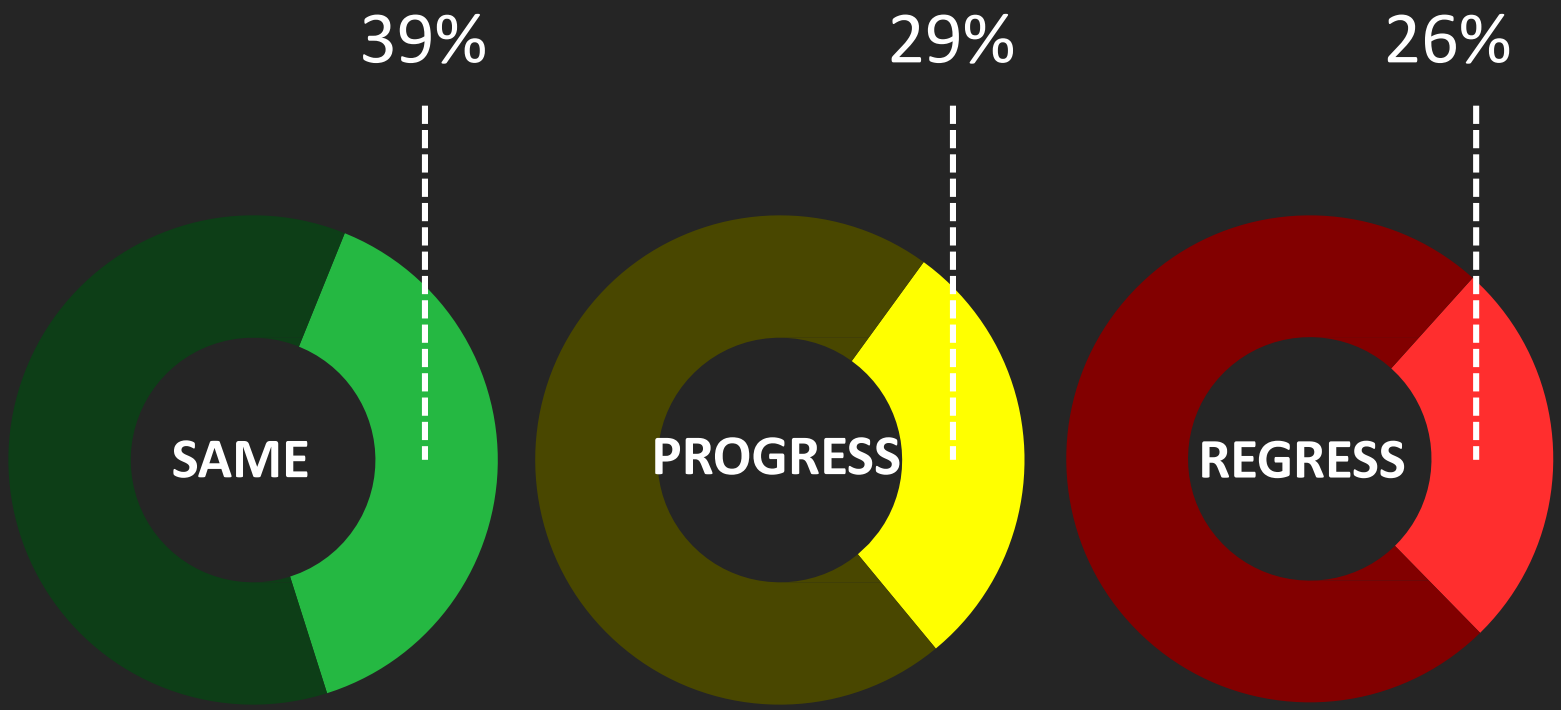
management

- patients should be encouraged to periodically test their central vision monocularly , such as increasing metamorphopsia or development of a small, central scotoma. *(good quality, strong recommendation)*

- Patients do not typically improve without vitrectomy surgery when the area of VMT is broad (>1500 µm), when there is a pathologic detachment of the macula, or when the presenting VA is poor.

ERM

Using fundus photography, a population-based study of 3654 persons with 5 years follow up



Observation without treatment

- A study using SD-OCT images found that the ERM separated from the retina in only 16 of 1091 (1.5%) eyes with a pre-existing PVD
- in 21 of 157 (13.6%) of eyes that did not have an apparent PVD over a mean follow-up of 33 months.

VITREOMACULAR TRACTION

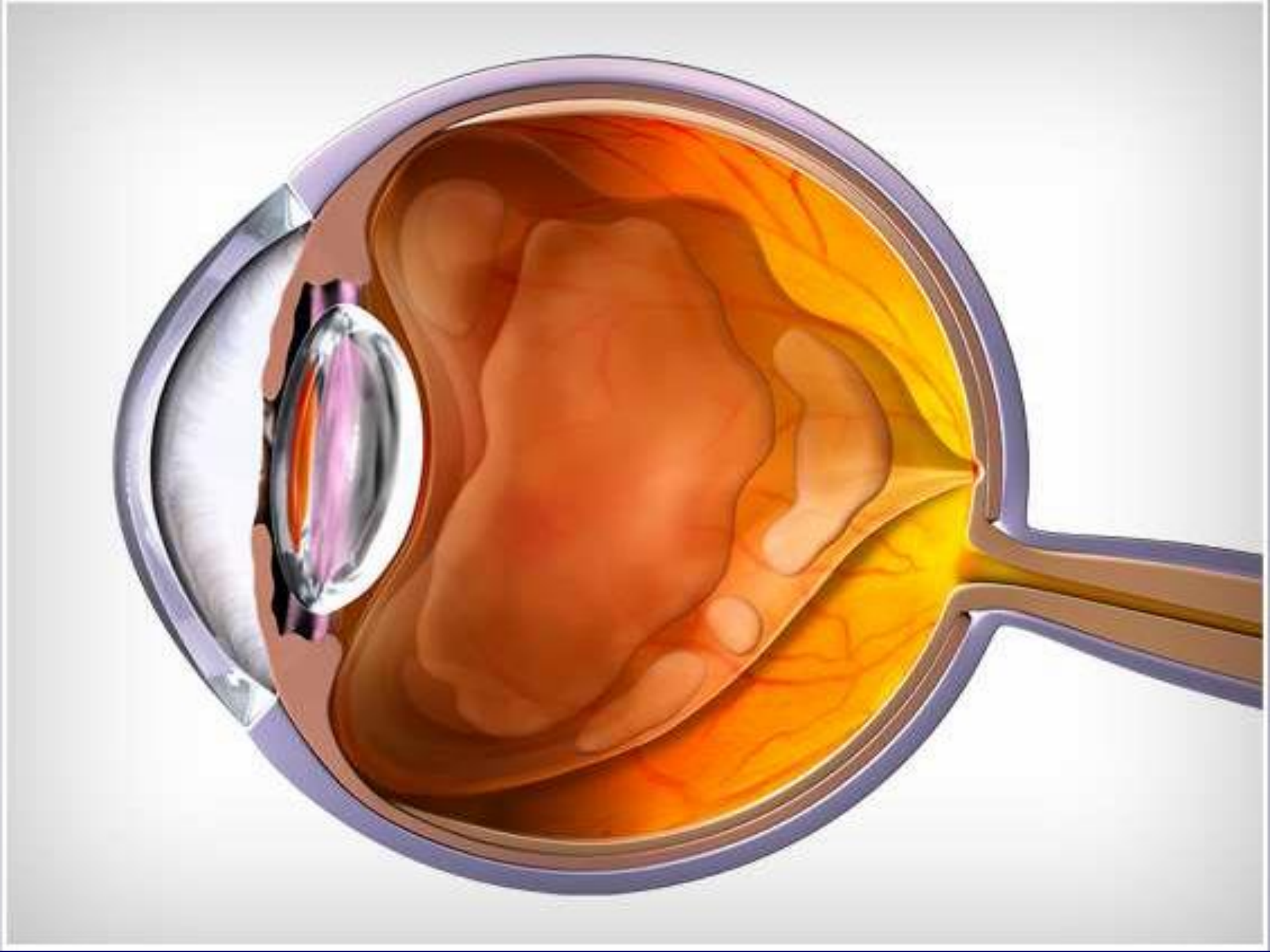
Definition

VMA

Vitreomacular adhesion is an attachment of the posterior cortical vitreous to the macula.

VMT

Vitreomacular traction occurs when the posterior cortical vitreous partially separates from the retina yet some tractional areas remain adherent to portions of the macula.



PVD → floaters or flash or photopsia

PVD

If vitreous remain adherent to the macula → **VMA**

Perimacular vitreous separate from posterior retina yet remain adherant to a region near macula center
→intraretinal cystoid changes, SRF, tractional detachment

- The macular changes that result from either ERM or VMT lead to similar symptoms: reduced visual acuity, metamorphopsia, difficulty using both eyes together, and even diplopia

- at the 20-year follow-up examinations of the *Beaver Dam Eye Study population* (mean age of 74.1 years), spectral domain optical coherence tomography (SD-OCT) was used and documented

- The same study also documented the prevalence of VMT to be 1% to 2%

Pathogenesis

the process of a PVD may be a prolonged one and portions of the posterior cortical surface may remain adherent to the macula

tractional changes

- localized vitreomacular attachment of about 500 µm causes elevation, traction, and subsequent intraretinal cystoid spaces in the foveal neurosensory retina.

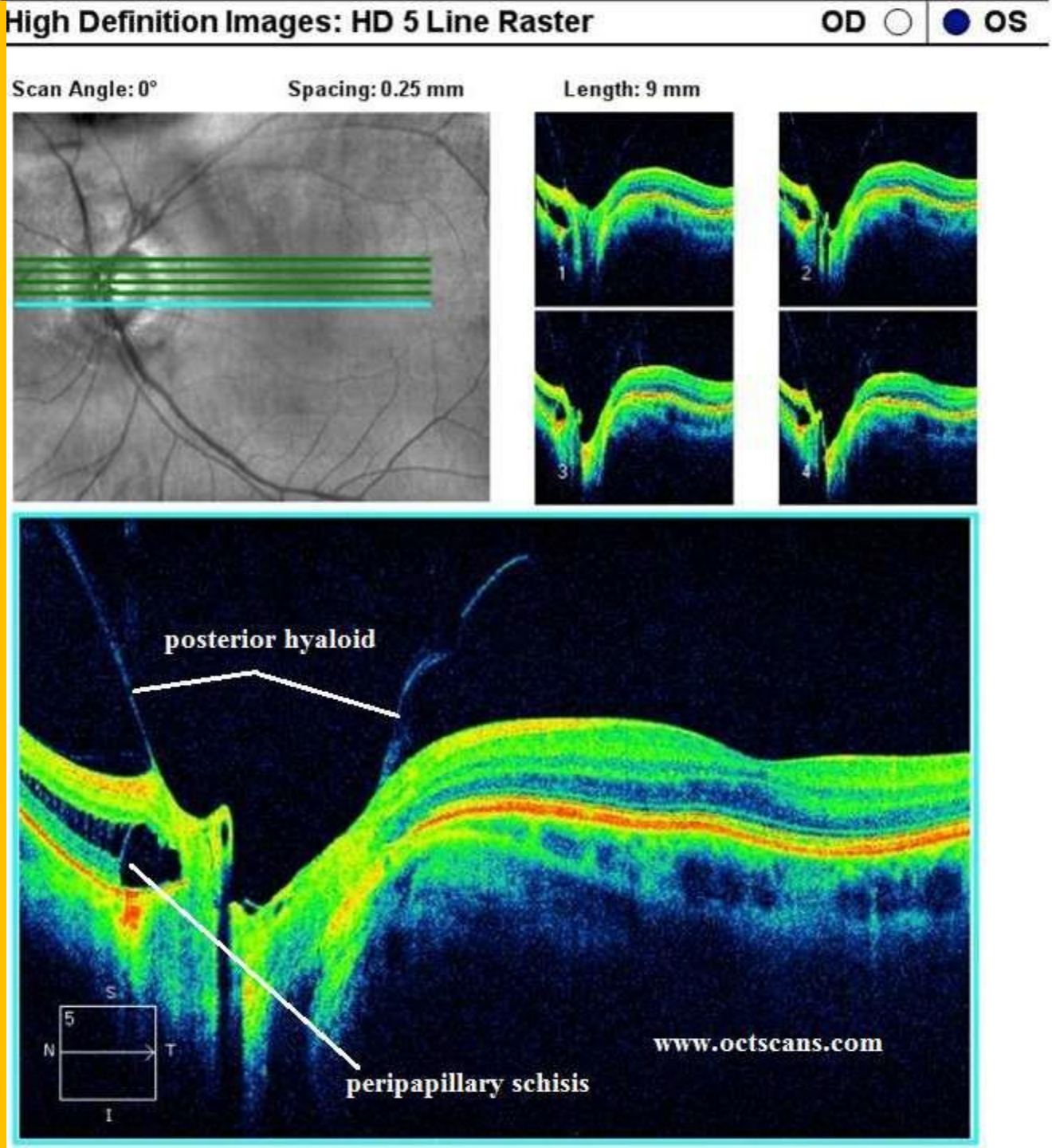
- A broad attachment measuring about 1500 µm (approximately one disc diameter) can cause more elevation of the macula, even to the point of a macular retinal detachment

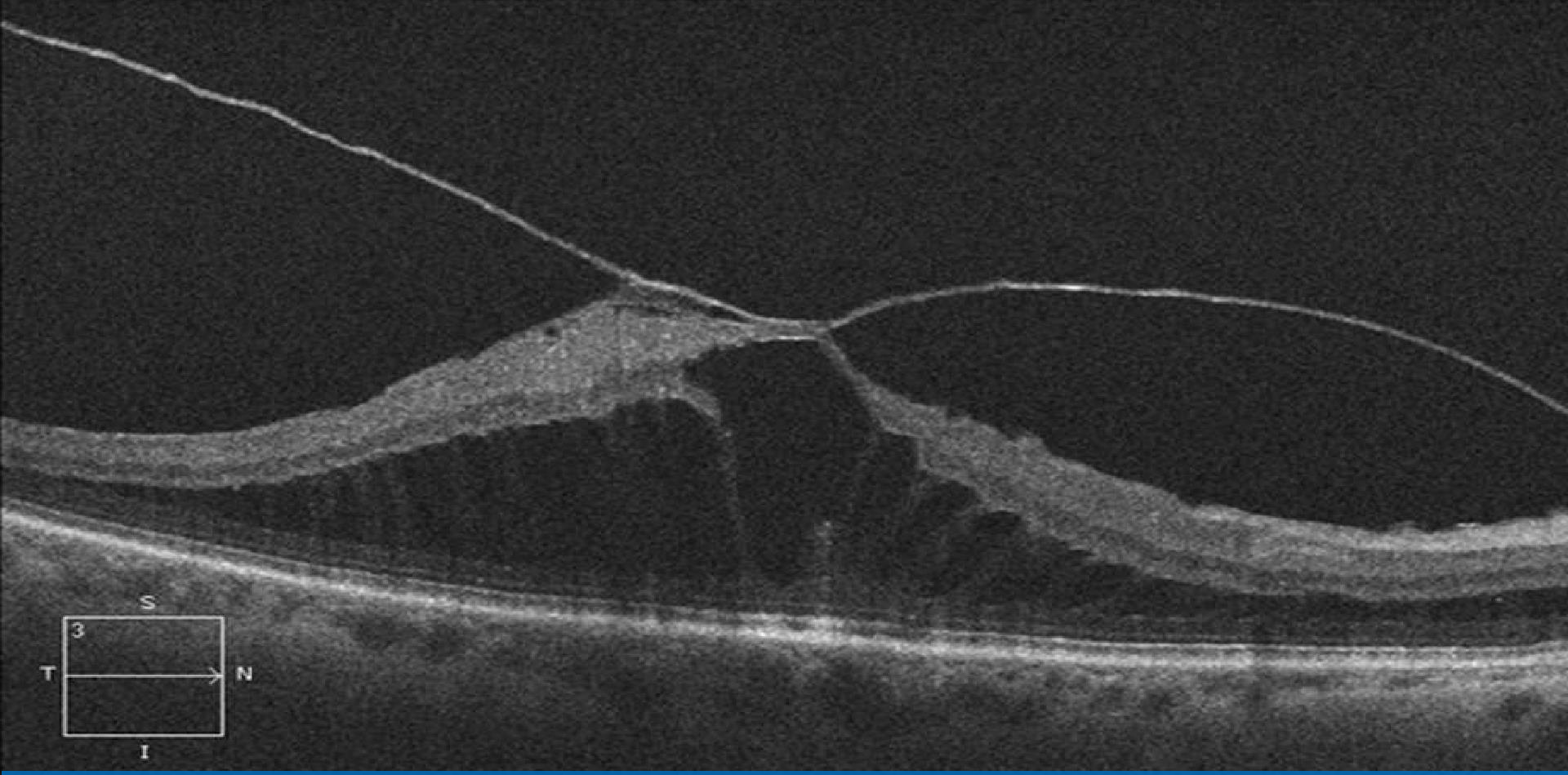
- Epiretinal membranes may evolve between the neurosensory retina and a vitreous attachment.
- Perhaps the ERMs are due to a wound-healing response.
- They adhere tightly to the ILM, and may play a role in VMT by binding the remaining attachment of the vitreous to the macula

clinical examination

- The macular changes in VMT are often similar to the changes of the retina that result from an ERM.
- In VMT, raised edges of adherent vitreous may be seen in a peripapillary distribution around the optic nerve head and is referred to as **vitreopapillary traction.**
- This condition can be confused with optic nerve disorders such as papilledema.

- There is some recent suspicion that vitreopapillary traction might be associated with decreased vision and even ischemic optic neuropathy.
- Further studies are required to verify this.





- The OCT findings of VMT are similar, except that the posterior hyaloid remains partially attached to the macula and is separated in the peri-macular region.
- Cystoid spaces may be present in the entire macular region in VMT

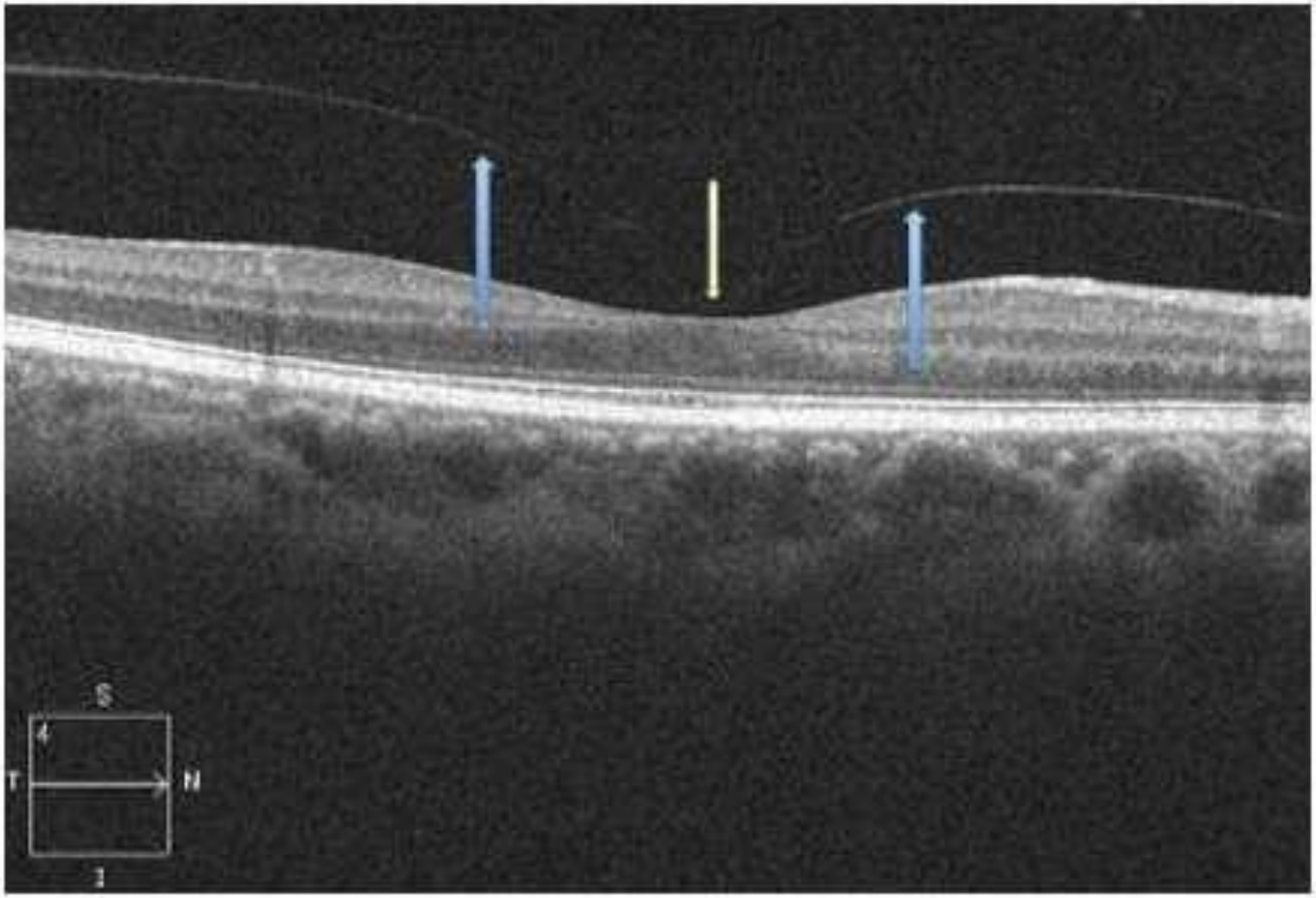


FIGURE 1. Vitreomacular adhesion (VMA). The posterior vitreous face (blue arrows) is separated from the neurosensory retina and a foveal attachment (yellow arrow) or VMA remains. Note that there is no secondary retinal pathology from this attachment site. (Courtesy of Timothy W. Olsen, MD)

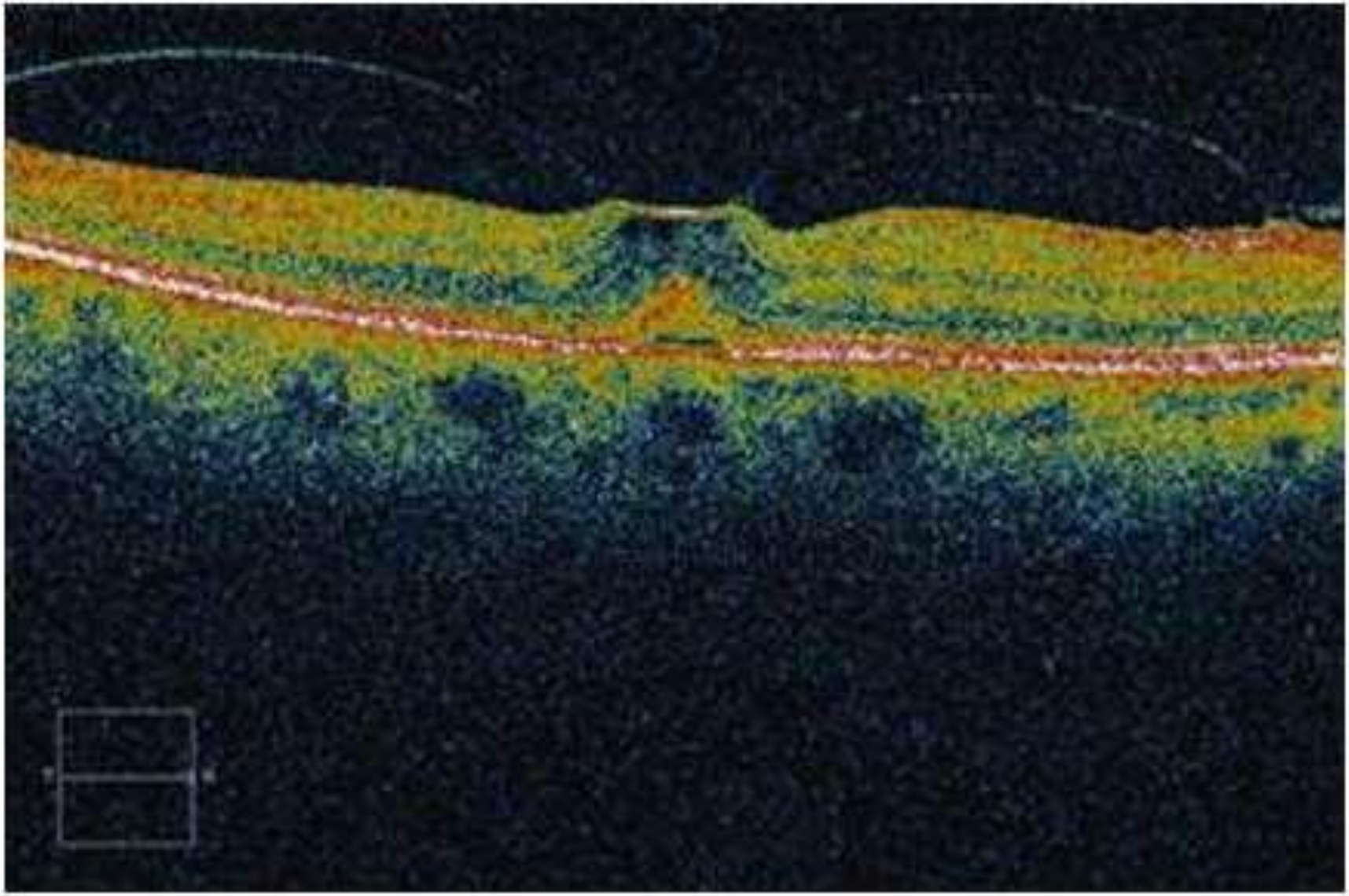


FIGURE 2. Vitreomacular traction. (Copyright © 2015 American Academy of Ophthalmology®)

observation

VMT

- In eyes with VMT of 1500 µm or less, patients often have stable visual acuity, and the incidence of spontaneous release of traction from the macula occurs in approximately 30% to 40% of eyes over a follow-up of 1 to 2 years

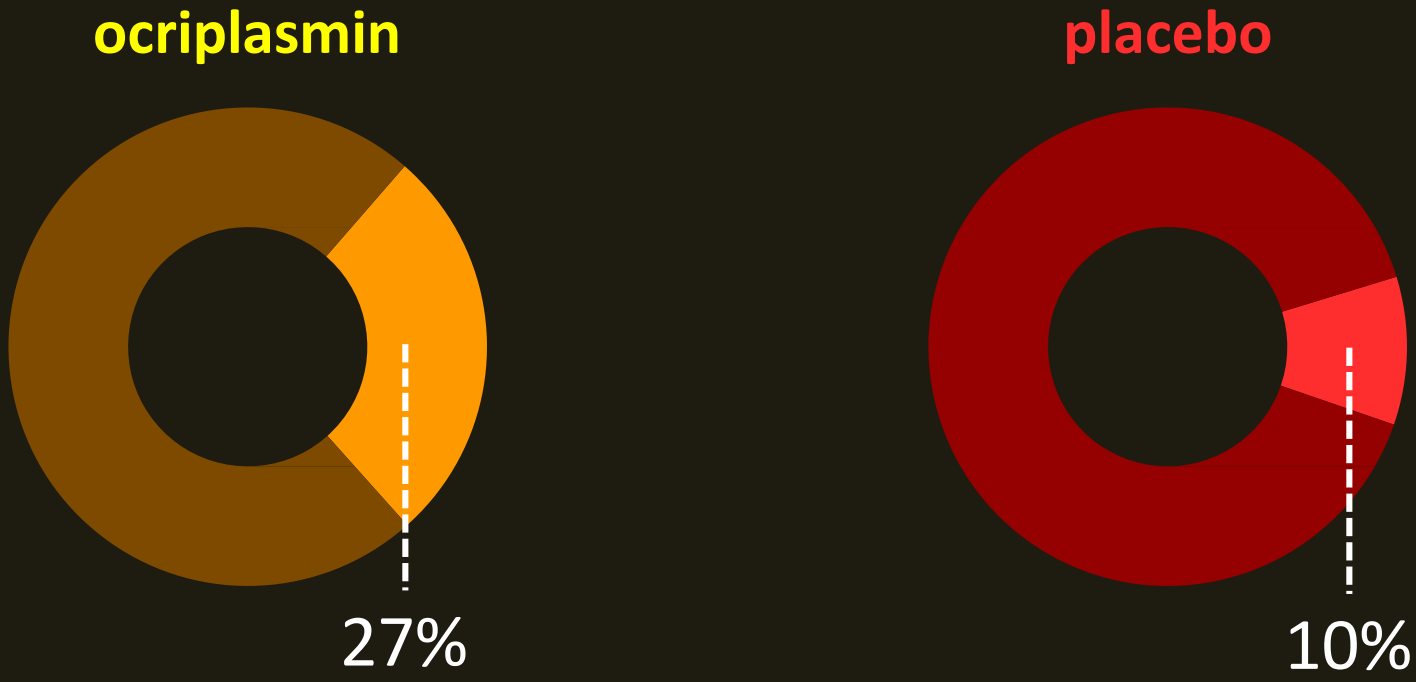
surgery

OCRIPLASMIN

- a recombinant proteolytic enzyme that was approved by the FDA for intravitreal injection for the treatment of symptomatic VMA (VMT) in 2012

- The ERM/VMT in this combination group released in 8.7% subjects receiving the drug compared with 1.5% in the placebo group

The inclusion criteria in the phase 3 studies of ocriplasmin included all eyes with vitreous traction on the macula, including a subset of eyes with stage 2 macular holes.



Overall, 27% of eyes in the ocriplasmin group reached the primary end point (resolution of VMA), compared with 10% of placebo-injected eyes ($P<0.001$).

Resolution of VMA might depend on these factors

1. younger patients (<65 years),
2. eyes without an ERM
3. eyes with a full-thickness macular hole and associated VMA
4. phakic eyes
5. and eyes with a focal VMA of 1500 µm or less

(III, good quality, strong recommendation)

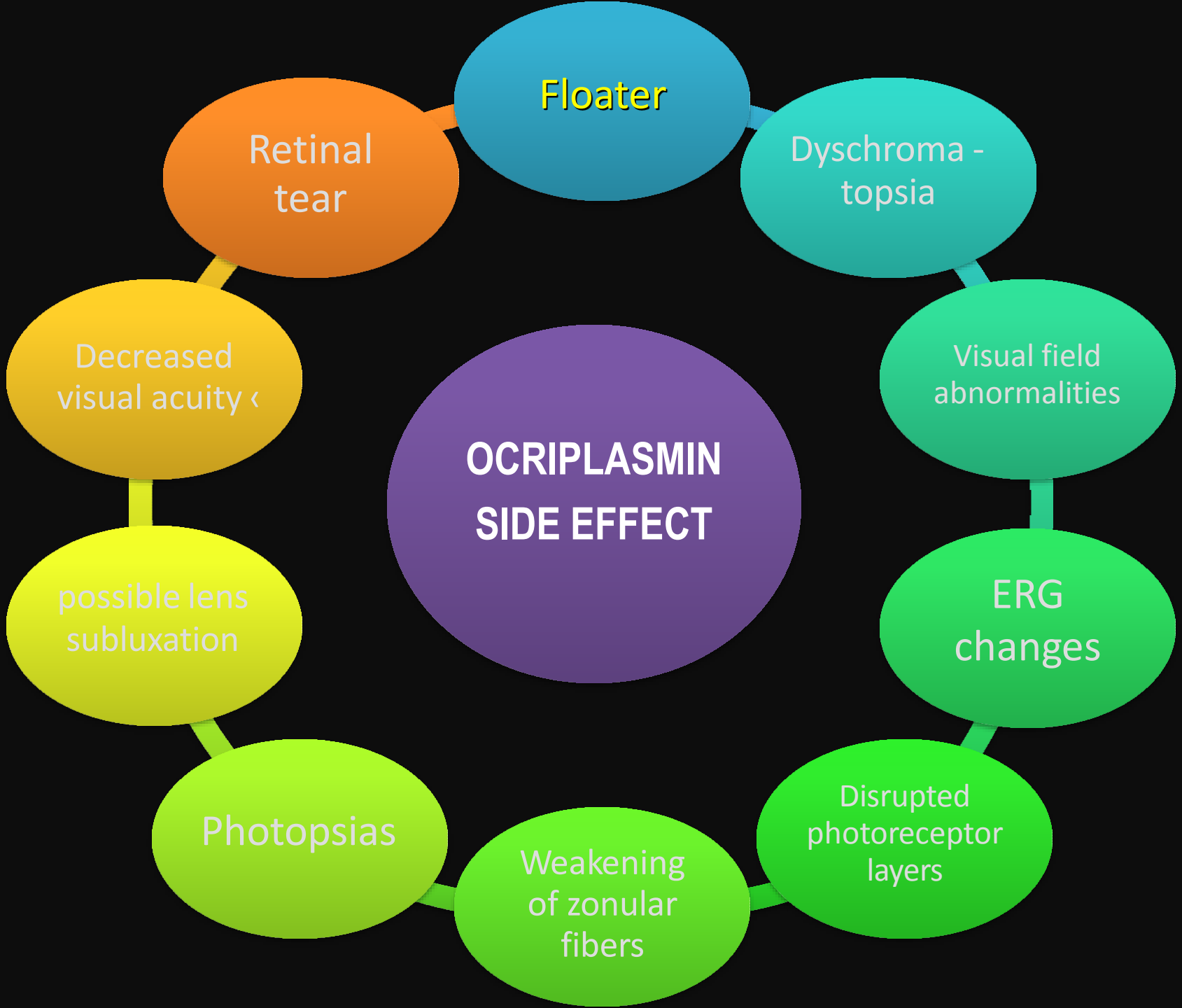
Complications of Ocriplasmin

- A review of the adverse effects in the two phase 3 ocriplasmin studies was performed and included 465 eyes treated with ocriplasmin and 187 eyes treated with placebo.

- During the first week after injection, the ocriplasmin group had about a **10% risk**
  - vitreous floaters
  - Photopsia
  - eye pain
  - combination of either blurred vision or decreased vision.
  - Most of these early symptoms resolved

Complications of Ocriplasmin

The greatest concern about potential toxicity was with acute severe vision loss, ERG abnormalities, dyschromatopsia, and disruption of the photoreceptor layers


OCRIPLASMIN
SIDE EFFECT
Floater
Dyschroma - topsia
Visual field abnormalities
ERG changes
Disrupted photoreceptor layers
Weakening of zonular fibers
Photopsias
possible lens subluxation
Decreased visual acuity ‹
Retinal tear

Gas Injection for VMT

The injection of intravitreal perfluorocarbon gas has been reported to also induce release of VMT and is the subject of ongoing clinical trials

SURGERY

- Vitrectomy Surgery Preoperative Discussion for Vitrectomy The preoperative discussion should include the risks (e.g., cataract, retinal tears, retinal detachment, endophthalmitis) versus the benefits of vitrectomy surgery

SURGERY

- High risk of cataract progression in phakic eyes
- Local anesthesia is prefered
- VA and symptoms of distortion will probably improve
- Variable IOP change

SURGERY

- Epiretinal membranes and VMT are often present in the same eye. During surgery, both the VMT and ERM must be removed from the retina surface

- Furthermore, removal of the ILM around the macula releases the traction even more completely and reduces the rate of recurrence

Surgical technique

- Surgical removal of ERM/VMT is usually performed using a 23-, 25-, or, more recently, 27-gauge vitrectomy system combined with local, monitored anesthesia care
- The core vitreous is removed
- induces a detachment of the posterior hyaloid from the optic nerve and macula
- Triamcinolone, indocyanine green or BBG dye may be used during surgery to highlight ILM and remaining vitreous
- The vitreous is commonly separated from the retina using aspiration
- The vitreous is separated from the retinal surface at least anteriorly to the equator, and then removed
- the ERM and frequently the ILM are removed with intraocular forceps

ERM removal VS ERM+ILM removal

- Removal of the Internal Limiting Membrane lists seven studies that compare the results of removing the ERM alone with removing both the ERM and ILM.
- Five of the studies found that peeling the ILM with the ERM led to a lower incidence of recurrent ERM.
- Two studies showed no difference between peeling or not peeling the ILM.
- **No article reported better results for peeling the ERM alone**

TABLE 1 RESULTS OF NO ILM PEEL VS. ILM PEEL IN ERM AND VMT

Study	No. of Eyes with ERM	Results	Follow-up (mos)	ERM Removal with or without ILM Peel Was Not Favored	Removal of Both ILM and ERM Was Favored
Bovey et al, 2004[75]	71	ERMs peeled with no attempt to peel ILM but ERM then studied by histopathology. 55 of 71 eyes had long segments of ILM and 16 did not: the 55, which had ILM, had three lines of vision gain compared to one line in non-ILM group; recurrence rate of ERM was 9% in ILM group and 56% in non-ILM group.	Range 6–59; mean 21.7		•
Kwok et al, 2005[76]	42	17 ERMs removed with no ILM peel, and in 25 eyes both ERM and ILM were peeled. Postop VA was logMAR 0.65 in the non-ILM peel group and 0.46 in the peel group. ERM recurred in 3/17 non-ILM peel group and 0/25 of ILM peel group.	Mean 32.8		•
Oh et al, 2013[77]	43	23 eyes ERM only; 20 eyes ERM and ILM peeled. ILM peel group was not favored at 3 mos. No difference between two groups at 12 months for VA, central retinal thickness, and mfERG.	12	•	
Park et al, 2003[78]	44	24 eyes no ILM peel (Group A); 20 eyes with ILM peel (Group B). Average increase in logMAR was 0.33 in Group A and 0.41 in Group B. Recurrence rate f ERM was 21% in Group A and none in Group B.	At least 3		•
Sandali et al, 2013[79]	440	174 eyes no ILM peel; 266 eyes had ILM peel. VA improvement postop was the same between two groups; VA same with dye-assisted ILM peel compared with none. Recurrence rate of ERM was in 8.6% in non-ILM peel group and 2.6% in ILM peel.	At least 12	•	
Shimada et al, 2009[80]	246	104 eyes ERM removed only; 142 eyes ERM and ILM removed. Recurrence rate of ERM was 17/104 (16.3%) in ERM-only group and 0/142 eyes in ERM/ILM group. Postop VA did not differ between the groups.	12		•
Koestinger and Bovey, 2005[81]	75	ERM removed in only 55 eyes and ILM also peeled in 20 eyes using ICG to stain. No difference in VA between groups.	Mean 20	•	

ERM = epiretinal membrane; ILM = internal limiting membrane; mfERG = multifocal electroretinography; Postop = postoperative; VA = visual acuity; VMT = vitreomacular traction

Outcome

- Vitrectomy surgery is often indicated in patients who are affected with a decrease in visual acuity, metamorphopsia, double vision, or difficulty using their eyes together.

- The visual results are excellent, however; 80% patients have more visual acuity gain, 10% to 20% of them will have unchanged vision following surgery with anatomical improvement

- Scores on the NEI Vision Function Questionnaire, on average, improve postoperatively.
- Most metamorphopsia improves and may normalize
- Most patients are pleased with the relief from some or all of the metamorphopsia.
- In 50 eyes that had ERM along with cystoid macular changes, lamellar holes, or pseudoholes, the mean visual acuity improved postoperatively by two or more lines and over 70% had a visual acuity of 20/50 or better.

- Of 30 eyes that had a lamellar macular hole secondary to an ERM, the preoperative acuity improved a mean of 3.4 lines after 17 months.

TABLE 2 RESULTS OF VITRECTOMY FOR EPIRETINAL MEMBRANE AND VITREOMACULAR TRACTION

Study	No. of Patients	Diagnosis	Results	Follow-up (mos)
Bouwens et al, 2008[84]	107	ERM	Mean postop gain two lines; 83% had less metamorphopsia	Results at 12
Dawson et al, 2014[85]	237	ERM	Mean preop 20/120; mean postop 20/40	6
Ghazi-Nouri et al, 2006[86]		ERM	No postop gain in mean VA; 40% gained two lines or better; metamorphopsia decreased significantly (P=0.02); VFQ-25 improved significantly (P=0.03)	4
Koerner and Garweg, 1999[55]	60	ERM	73% improved vision; 57% better than preop; 61% 20/50 or better; 57% final VA better than preop	Mean 24.7
Koerner and Garweg, 1999[55]	50	VMT	73% improved vision; 60% better vision than preop; 66% 20/50 or better; 60% final VA better than preop	Mean 10
Matsuoka et al, 2012[87]	26	ERM	LogMAR VA 0.41 preop, 0.17 at 3 mos, 0.10 at 12 mos; metamorphopsia score (base, 3, and 12 mos was 202, 137, and 108; VFQ-25 scores significantly better at 3 and 12 mos	12
Okamoto et al, 2009[88]	28	ERM	LogMAR improved from 0.49 preop to 0.24 postop; 11 (39%) had no change in logMAR; VFQ-25 scores significantly improved	3
Garcia-Fernandez et al, 2013[89]	88	ERM	82% had better vision but 10% worse postop	12
Arndt et al, 2007[35]	85	ERM	56% of patients had metamorphopsia preop and 13% postop	12
Wong et al, 2005[90]	125	ERM	VA improved by a mean of 0.31 log units or three lines of vision; 16% had unchanged acuity postop	10.3
Witkin et al, 2010[58]	20	VMT	Mean VA preop was 20/122 and postop was 20/68	28.6
Jackson et al, 2013[91]	Meta-analysis 259 eyes from 17 articles	VMT	Mean preop logMAR 0.67; mean postop 0.42; 33% gained two or more lines; 21% of eyes had same or decreased VA postop	Variable; range 6–35

ERM = epiretinal membrane; logMAR = logarithm of the minimum angle of resolution; Postop = postoperative; Preop = preoperative; VA = visual acuity; VFQ-25 = National Eye Institute Visual Function Questionnaire; VMT = vitreomacular traction

Predictors of Visual Results after Surgery

IS/OS

- A study of 43 eyes showed that an intact inner photoreceptor and ellipsoid zone (EZ), also referred to as the inner segment/outer segment junction (IS/OS), was associated preoperatively with…

better VA after a vitrectomy for ERM using OCT.

- Complications The majority of phakic patients develop a progressive **nuclear cataract** following vitrectomy for ERM.

- Retinal breaks and detachments are less common with current vitrectomy surgery

Follow-up Evaluation

- After Surgery Patients are examined on
  - postoperative day 1
  - 6 weeks following surgery, depending upon the development of new symptoms or new findings during early postoperative examination.
    (good quality, strong recommendation)

Follow-up Evaluation

- Interval history, including new symptoms
  Measurement of IOP
- Slit-lamp biomicroscopy of the anterior segment, including the wound sites and central retina, if possible
- Indirect binocular ophthalmoscopy of the peripheral retina
- Counseling on the use of postoperative medications
  Counseling on the signs and symptoms of retinal detachment
- Precautions about intraocular gas precautions, if it has
- been used


TAKE HOME MESSAGE

TAKE HOME MESSAGE

- Epiretinal membranes (ERMs) are sheet-like structures that develop on the inner surface of the neurosensory retina.
- Vitreomacular traction (VMT) occurs when the posterior cortical vitreous partially separates from the retina yet some tractional areas remain adherent to portions of the macula and cause retinal pathology.
- Epiretinal membranes and VMT often occur together in the same eye.
- Spectral domain optical coherence tomography (SD-OCT) is a highly sensitive and routine methodology used to diagnose and characterize ERM, VMT, and associated retinal changes.

TAKE HOME MESSAGE

- Increasing age and other retinal pathologies (e.g., posterior vitreous detachment (PVD), uveitis, retinal breaks, retinal vein occlusions, proliferative diabetic retinopathy, and ocular inflammatory diseases) have been identified as consistent risk factors for ERM. The prevalence of ERM appears to vary by ethnicity, but the variations are not consistent across studies.

TAKE HOME MESSAGE

- **Vitrectomy surgery** is often indicated in patients who are affected with a decrease in visual acuity, metamorphopsia, double vision, or difficulty using their eyes together. Vitrectomy surgery for ERM or VMT usually leads to **improvement of the metamorphopsia and visual acuity**.

- On average, approximately 80% of patients with ERM or VMT will improve by at least two lines of visual acuity following vitrectomy surgery.

TAKE HOME MESSAGE

- **Ocriplasmin** is a recombinant proteolytic enzyme that has been approved by the FDA for intravitreal injection for the treatment of symptomatic vitreomacular adhesion (VMA). It works best to release vitreous traction in younger patients (<65 years), eyes without an ERM, eyes with a full-thickness macular hole and associated VMA, phakic eyes, and eyes with a focal VMA of 1500 µm or less.

- Side effects of ocriplasmin should be kept in mind


THANK YOU