STATE BOARD OF OPTOMETRY
2450 DEL PASO ROAD, SUITE 105, SACRAMENTO, CA 95834
P (916) 575-7170 F (916) 575-7292 www.optometry .ca.gov

Continuing Education Course Approval Checklist

Title: Taste of the Islands: Vitreous: Friend or Foe

Provider Name: Coastal Vision Medical Group c/o Ms. Gina Valdemar

☑Completed Application
Open to all Optometrists? ☑Yes ☐No
Maintain Record Agreement? ☑Yes ☐No

☑Correct Application Fee

☑Detailed Course Summary

☑Detailed Course Outline

☑PowerPoint and/or other Presentation Materials

☐Advertising (optional)

☑CV for EACH Course Instructor

☑License Verification for Each Course Instructor
Disciplinary History? ☐Yes ☑No

CALIFORNIA STATE BOARD OF OPTOMETRY

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CONTINUING EDUCATION COURSE APPROVAL APPLICATION

$50 Mandatory

Pursuant to California Code of Regulations (CCR) § 1536, the Board will approve continuing education (CE) courses after receiving the applicable fee, the requested information below and it has been determined that the course meets criteria specified in CCR § 1536(g).

In addition to the information requested below, please attach a copy of the course schedule and topical outline of the subject matter. Applications must be submitted 45 days prior to the course presentation date.

Please type or print clearly.

Course Title "Taste of the Islands CE" "Vitreous: Friend or Foe"	**Course Presentation Date** 8am - 4:30 pm 04/30/2017

Course Provider Contact Information

Provider Name Coastal Vision Medical Group

Gina (First) Valdemar (Last) _____ (Middle)

Provider Mailing Address

Street 293 S. Main St. #100 **City** Orange **State** CA **Zip** 92868

Provider Email Address gina.valdemar@coastal-vision.com

Will the proposed course be open to all California licensed optometrists?	☒ YES ☐ NO
Do you agree to maintain and furnish to the Board and/or attending licensee such records of course content and attendance as the Board requires, for a period of at least three years from the date of course presentation?	☒ YES ☐ NO

Course Instructor Information

Please provide the information below and attach the curriculum vitae for each instructor or lecturer involved in the course. If there are more instructors in the course, please provide the requested information on a separate sheet of paper.

Instructor Name

Raj (First) Ratnod (Last) _____ (Middle)

License Number A120894	**License Type** MD
Phone Number (714) 746-9679	**Email Address** gina.valdemar@coastal-vision.com

I declare under penalty of perjury under the laws of the State of California that all the information submitted on this form and on any accompanying attachments submitted is true and correct.

Signature of Course Provider 3-20-17 *Date*

COASTALVISION
Technique. Technology. Trust.

March 23, 2017

State Board of Optometry
2450 Del Paso Road, Ste. 105
Sacramento, CA 95834

RE: Late submission of CE course approval-Taste of the Islands 8 Hour CE-April 30, 2017: Five Retinal Diagnoses You Don't Want to Miss; Cataract Surgery in Patients with Corneal Pathology; Buried Treasure: Connecting the Dots to Treating Binocular Misalignment; Patient-reported Outcomes with Lasik: Interpreting the PROWL study; What We Know about Topography Guided Refractive Surgery: Case Studies in Clinical Practice; Do You See What I See?; Crosslinking for Corneal Ectasia: The Evolution of Sclera Lenses; Blink and You'll Miss It: Dry Eye in the Cosmetic Patient; Is the Symfony Toric Lens the Answer for Every Eye Condition; Should My Glaucoma Patient with a Cataract have a MIGS Surgery; Vitreous: Friend or Foe; Is it Cancer? The Optometrist Role in the Diagnosis and Management of Periocular Skin Cancer; Oral Presentations of Systemic Disease: Case Presentations; Glaucoma Management: What Should I do Next?

Dear Practice and Education committee,

I am writing this letter in regards to late submission for the multi-course symposium titled "Taste of the Islands CE" scheduled for presentation on 04/30/2017. We are short of the 45 day submission request, and wanted to include a letter for late submission with our CE approval application.

We continue to work diligently to get all required items to the board needed for CE approval in a timely manner. Due to multiple speakers at the upcoming CE, we had difficulty obtaining all the lectures to meet the submission requirement timeline and would appreciation your consideration of our continuing education approval request.

Please feel free to reach out to us with any other questions. We look forward to continued relations with the State Board of Optometry and the practice and education committee.

Sincerely,

Gina Valdemar
Affiliate Relations and Education Director
Coastal Vision Medical Group
ginavaldemar@coastal-vision.com

Schedule of Events:

7:00 am-7:50 am	Registration & Breakfast	
7:50 am-8:00 am	Dan B. Tran, MD	Welcome & Opening Remarks
8:00 am-8:25 am	Timothy You, MD	5 Retinal Diagnoses You Don't Want to Miss
8:25 am-8:50 am	Jennifer Lee Wu, MD	Cataract Surgery in Patients with Corneal Pathology
8:50 am-9:15 am	Gary Lovcik, OD	Buried Treasure: Connecting the Dots to Treating Binocular Misalignment
9:15 am-9:40 am	Elizabeth Hofmeister, MD, MC, USN	Patient-reported Outcomes with LASIK: Interpreting the PROWL Study
9:40 am-10:05 am	Dan B. Tran, MD	What We Know about Topography Guided Refractive Surgery: Case Studies in Clinical Practice
10:05 am-10:30 am	Madhu Agarwal, MD	Do You See What I See?
10:30 am-11:00 am	Break	
11:00 am-11:50 am	Jennifer Lee Wu, MD	Crosslinking for Corneal Ectasia
11:50 am-12:15 pm	Justin Kwan, OD, FAAO	The Evolution of Sclera Lenses
12:15 pm-12:40 pm	Jeffrey Joseph, MD	Blink and You'll Miss It: Dry Eye in the Cosmetic Patient
12:40 pm-1:50 pm	Lunch/Luau	
1:50 pm-2:15 pm	Dan B. Tran, MD	Is the Symfony Toric Lens the Answer for Every Eye Condition?
2:15 pm-2:40 pm	Betsy Nguyen, MD	Should My Glaucoma Patient with a Cataract have a MIGS Surgery?
2:40 pm-3:05 pm	Raj Rathod, MD, MBA	Vitreous: Friend or Foe
3:10 pm-3:35 pm	Jeffrey Joseph, MD	Is it Cancer? The Optometrist's Role in the Diagnosis and Management of Periocular Skin Cancer
3:35pm-3:40 pm	Lisa D. Garbutt, MD	Ocular Presentations of Systemic Disease: Case Presentations
4:00 pm-4:25 pm	Betsy Nguyen, MD	Glaucoma Management: What Should I Do Next?
4:25 pm-4:30 pm	Closing Remarks/Raffle	

*At time of print, pending CA Board of Optometry approval. Topics and speakers are subject to change.

COASTALVISION
Medical Group Inc.

Taste of the Islands 8 hour CE
(12 of 15 lectures)

Course Title: Vitreous: Friend or Foe

Course Presentation date: 4/30/17

Speaker: Raj Rathod, MD, MBA

Target Audience: This lecture is intended for optometrist seeking continuing education

Course Description: Discussion to include function, anatomy, development and biochemistry of the vitreous. Pathology and Age related changes; Syneresis, Asteroid Hyalosis, Vitreous Inflammations, Secondary inflammations, Active Toxoplasmosis, Hemorrhage, and procedures.

CE Credit: .50 CE Units

1 **Vitreous: Friend or Foe?**

Raj Rathod, MD, MBA
Orange County Retina

2 **VITREOUS**

3 **I. FUNCTION OF THE VITREOUS**

- A. Screen out UV and IR light
- B. Provide a clear media for optical transmission
- C. Protection of the retina

4

5

6 **II. ANATOMY**

- A. Largely an acellular, connective tissue structure
  - 1. mass of 3.9 grams
  - 2. approximately 99 % water
  - 3. 1 % solid
    - 0.9% salts
    - 0.08% protein
    - 0.02% mucopolysaccharide
  -

7

  - 4. occupies 60 % of the globe
  - 5. index equivalent to the aqueous, n = 1.334
  - 6. some cells located in the anterior portion of the vitreous near the ciliary epithelium

8

9

10 **III. DEVELOPMENT OF THE VITREOUS**

- A. The primary vitreous develops at the end of the third embryonic week
  - 1. the primary vitreous is behind the lens vesicle and is formed by mesoderm that migrates between the optic cup and the lens vesicle
  - 2. is primarily the hyaloid vasculature
    - a. artery that supplies nutrients to the tissue behind the lens and the lens

11

12 **III. DEVELOPMENT OF THE VITREOUS**

    - b. the hyaloid vasculature dissolves before birth
      - i. the process is autolytic, i.e. the vasculature dissolves itself
      - ii. no macrophages enter the area from outside
    - c. the canal that is left after the primary vitreous dissolves is called the canal of Cloquet or the hyaloid canal
    - d. floaters

13

14 **III. DEVELOPMENT OF THE VITREOUS**

- B. The secondary vitreous starts to develop by the ninth week
  - 1. this becomes the mature vitreous
  - 2. mostly acellular and fibrous
  - 3. synthesized by the primary vitreal cells and retinal glial cells, i.e., neuroectoderm in origin

15 **III. DEVELOPMENT OF THE VITREOUS**

- 4. eventually fills the globe and compacts the primary vitreous
  - a. there is a condensed area of vitreous that separates the primary and secondary vitreous
- 5. the secondary vitreous has a condensed area of vitreous at its periphery
  - a. acts like an outer skin

16 **III. DEVELOPMENT OF THE VITREOUS**

- C. The tertiary vitreous (zonular fibers) begins to develop at 6 months embryonically
  - 1. the fibrous structure of the secondary vitreous condenses and forms the zonules
  - 2. the zonules merge with the lens capsule and the basement membrane of the ciliary body

17 **Persistent Hyperplastic Primary Vitreous**

18

19 **IV. VITREOUS ATTACHMENTS**

- A. Anteriorly
  - 1. Wieger's Hyaloideo-Capsular Ligament
  - 2. Ora Serrata (anterior vitreous base)
- B. Posteriorly
  - 1. Optic Nerve Head (posterior vitreous base)
  - 2. Blood Vessels of the Retina and the Macula

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21

22 **V. CELLS OF THE VITREOUS**

- A. Hyalocytes
  - 1. possibly originate from monocytes thus not intrinsic to the vitreous
  - 2. located in the anterior cortical vitreous near the ciliary body
  - 3. have a half-life of about a week
  - 4. only known function is to produce hyaluronic acid

23

24 **VI. BIOCHEMISTRY OF THE VITREOUS**

- A. Composition
  - 1. vitreous body
  - 2. vitreous humor
  - 3. collagen gives the vitreous its substance and the sodium hyaluronate provides the viscoelasticity

25 **VI. BIOCHEMISTRY OF THE VITREOUS**

- B. The human vitreous is typically a gel
  - 1. composed of randomly arranged collagen fibers and soluble hyaluronic acid (sodium hyaluronate)

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28 **VI. BIOCHEMISTRY OF THE VITREOUS**

- C. Collagen
  - 1. the protein of the vitreous is called vitrosin
    - a. determined to be collagen for several reasons
      - i. has the amino acid hydroxyproline which is specific to collagen
      - ii. has a shrinkage temperature of 60 to 65 degrees centigrade, the same as collagen
      - iii. has the same X-ray diffraction properties as collagen

29 **VI. BIOCHEMISTRY OF THE VITREOUS**

    - b. properties different from collagen
      - i. 4% to 9% of the weight of vitrosin is a complex polysaccharide that can not be separated from it
      - ii. The polyacrylamide gel electrophoretic pattern of vitrosin does not match collagens types I, II, III or IV
      - iii. only 60% to 93% of the vitreous framework can be dissolved with collagenase

30 **VI. BIOCHEMISTRY OF THE VITREOUS**

  - 2. the collagen content of the vitreous is highest where it is a gel, at the vitreous cortex
  - 3. there are species differences in collagen content
    - a. the higher the collagen content the higher the viscosity of the vitreous

31 **VI. BIOCHEMISTRY OF THE VITREOUS**

- D. Sodium Hyaluronate
  - 1. a repeating chain of disaccharide units made up of N-acetyl-D-glucosamine and D-glucuronic acid

32

  - 2. the molecular weight is between 10,000 and 1,000,000
  - 3. hydrophilic in nature
  - 4. most concentrated in the cortical vitreous

33 **VI. BIOCHEMISTRY OF THE VITREOUS**

- 5. turnover rate is 0.45 micro-grams/ day
- 6. controls the viscosity of the vitreous
- 7. the liquid portion of the vitreous increases with age

34

35 **VI. BIOCHEMISTRY OF THE VITREOUS**

- E. Normal Ionic Composition
  - 1. the vitreous, except for collagen and sodium hyaluronate, is very similar to the aqueous
    - a. Oxygen
      - i. the oxygen in the vitreous comes from the arteries of the retina

36 **VI. BIOCHEMISTRY OF THE VITREOUS**

- b. Water
  - i. the water in the vitreous is exchanged about every 30 minutes
  - ii. water movement of 85 mm3 / min
- c. Sodium
  - i. sodium enters anteriorly from the ciliary body and posterior chamber
  - ii. 90 % of the sodium in the vitreous is exchanged in 24 hours, mainly flows to the aqueous - demonstrated with intravitreal injections of hot sodium

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39 **VI. BIOCHEMISTRY OF THE VITREOUS**

- d. Potassium
  - i. enters by active transport through the ciliary epithelium into the posterior chamber
  - ii. diffuses into the vitreous from lens and posterior chamber
  - iii. exits through the retina
- e. Chloride
  - i. there is a gradient of chloride from the vitreous to the aqueous
  - ii. chloride removed via the retina and the posterior chamber

40 **VI. BIOCHEMISTRY OF THE VITREOUS**

- f. Phosphate
  - i. enters the vitreous via the ciliary body
  - ii. low concentration in the vitreous because is used by the retina
  - iii. if retina damaged, concentration of phosphate goes up in vitreous
- g. Glucose
  - i. glucose diffuses into the vitreous from all tissues, principally the retina
  - ii. due to viscosity of vitreous, diffusion into vitreous slower than into aqueous

41 **VI. BIOCHEMISTRY OF THE VITREOUS**

- h. Proteins
  - i. the blood-vitreal barrier blocks the movement of most proteins into the vitreous

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43 **VI. BIOCHEMISTRY OF THE VITREOUS**

- F. The Blood-Vitreal Barrier
  - 1. a specific blood-vitreal barrier has been inferred from the many molecules that have different concentrations in the vitreous and the aqueous (thus not just an aqueous extract)
  - 2. few molecules penetrate the vitreous, small molecules penetrate better than large ones.

44 **VI. BIOCHEMISTRY OF THE VITREOUS**

- a. Fluorescein
  - i. intra-vitreal injections demonstrate that the blood-vitreal barrier is 27 to 38 times more permeable in the outward direction than the inward direction for fluorescein
- b. Antibiotics
  - i. most antibiotics do not have good penetration into the vitreous
  - ii. additionally when they are injected into the vitreous they are readily removed by a carrier mechanism

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46 **VI. BIOCHEMISTRY OF THE VITREOUS**

- iii. the carrier mechanism may be inhibited with the simultaneous injection of probenecid
- iv. penetration into the vitreous appears to be related to the liposolubility of the compound
  - 1. chloramphenicol is highly lipid soluble and penetrates the vitreous from the blood stream well so that therapeutic doses are achieved

47 **Summary: Blood Vitreous Barrier**

- Active pump to remove substances - in retinal vessels, RPE, and ciliary epithelium
- Lipid soluble substances have high permeability
- Mechanical barrier
  - vitreous meshwork

48 **Blood Aqueous Barrier**

- Mechanical Barrier
  - vascular endothelium, RPE, ciliary body epithelium

49 **BIOCHEMISTRY OF THE VITREOUS**

- G. Metabolism
  - 1. only the hyalocytes exhibit metabolic activity
    - a. principally the production of sodium hyaluronate
    - b. if all the hyaluronate is removed with an intravitreal injection of hyaluronidase it will be totally reformed in 6 weeks

50 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- A. Aging Changes
  - 1. Syneresis

- a. a breakdown of the vitreous gel
- b. fluid filled cavities form
- c. 65 % of those over the age of 60 have syneresis
- d. higher incidence in myopes

51 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- e. results in the fluid filled cavities enlarging and a possibility of the vitreous detaching from the retina
- f. with detachment the patient reports "flashing lights" and "floaters"
- g. more prone to retinal detachment

52 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- 2. Asteroid Hyalosis
  - a. hundreds of small spheres of calcium soaps are seen in the vitreous
  - b. are attached to the fibers of the vitreous so they move when the eye moves but always return to the same position
  - c. not associated with any systemic condition

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54 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- d. more common in the elderly
- e. no clinical significance
- f. does not effect vision
- g. 3 times more likely to be unilateral than bilateral

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60 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- 3. Synchysis Scintillans
  - a. usually bilateral
  - b. cholesterol crystals in the vitreous that are not attached
  - c. not associated with any systemic condition
  - d. no loss of vision
  - e. usually occurs before 40

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62 **Loa Loa Worm**

63 **VII. PATHOLOGY AND AGE RELATED CHANGES**

- B. Vitreous Inflammations
  - 1. Endophthalmitis
    - a. painful condition associated with photophobia, redness and edema of the

conjunctiva and lids
- b. rare
- c. usually caused by a penetrating injury that introduces Bacillus subtilis (found in the soil) into the vitreous
- d. infection usually destroys the eye, even with the administration of antibiotics

64 **Nail In The Vitreous**

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69 **VII. PATHOLOGY AND AGE RELATED CHANGES**
- 2. Secondary Inflammations
  - a. the majority of vitreal inflammations are secondary to inflammations of the choroid or retina
  - b. result in white blood cells in the vitreous that cause blurring of the retina and decrease in vision
  - c. generally resolves when the primary infection is treated
  - d. if vitreous does not clear may need to perform vitrectomy

70 **Active Toxoplasmosis**

71 **VII. PATHOLOGY AND AGE RELATED CHANGES**
- 3. Hemorrhage
  - a. can be minimal or the entire vitreous can be full
  - b. can result from trauma, diabetes, HBP or blood dyscrasias, i.e., leukemia
  - c. the treatment depends on the primary cause of the hemorrhage
    - i. may just follow or may need a vitrectomy

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75 **VII. PATHOLOGY AND AGE RELATED CHANGES**
- C. Vitrectomy
  - 1. this surgical procedure was not performed until the 1970's
  - 2. incision made in pars plana
  - 3. micro-surgical instrument inserted
    - a. takes up a small piece of vitreous, cuts it, removes it and then replaces with an equal volume of saline

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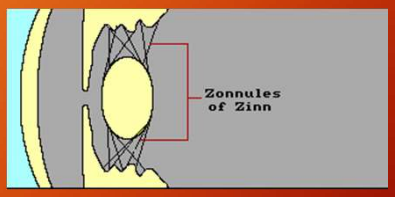
Vitreous: Friend or Foe?

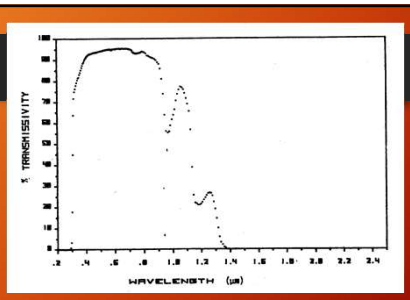
Raj Rathod, MD, MBA
Orange County Retina

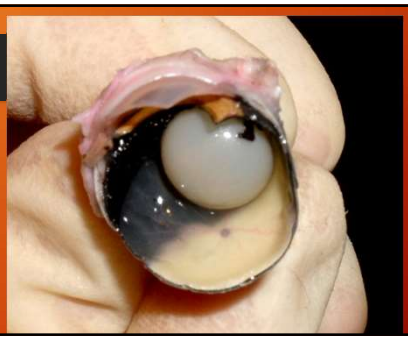
VITREOUS



I. FUNCTION OF THE VITREOUS

- A. Screen out UV and IR light
- B. Provide a clear media for optical transmission
- C. Protection of the retina

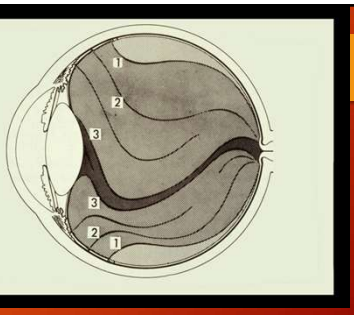


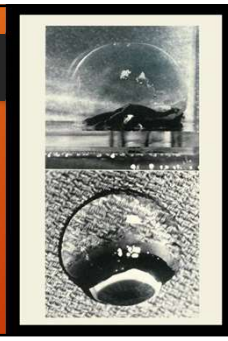


II. ANATOMY

- A. Largely an acellular, connective tissue structure
  - 1. mass of 3.9 grams
  - 2. approx mate y 99 % water
  - 3. 1 % so d
    - 0.9% sa ts
    - 0.08% prote n
    - 0.02% mucopo ysacchar de

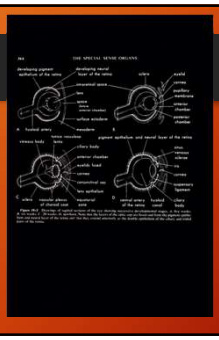
- 4. occup es 60 % of the globe
- 5. ndex equ va ent to the aqueous, n 1.334
- 6. some ce s ocated in the anterior portion of the vitreous near the ci ary ep the um





III. DEVELOPMENT OF THE VITREOUS

- A. The primary vitreous develops at the end of the third embryonic week
  - 1. the pr mary vitreous s behind the lens vesicle and is formed by mesoderm that m grates between the optic cup and the lens vesicle
  - 2. is pr mar y the hya o d vascu ature
    - a. artery that supp es nutr ents to the t ssue beh nd the ens and the ens



III. DEVELOPMENT OF THE VITREOUS

- b. the hya o d vascu ature d sso ves before b rth
  - . the process s auto yt c e. the vascu ature d sso ves se
  - . no macrophages enter he area from ou s de
- c. the cana that s eft after the pr mary v treous d sso ves s ca ed the cana of C oquet or the hya o d cana
- d. f oaters

III. DEVELOPMENT OF THE VITREOUS

- B. The secondary vitreous starts to develop by the ninth week
  - 1. th s becomes the mature vitreous
  - 2. most y ace u ar and f brous
  - 3. synthesized by the primary vitreal cells and ret nal gl a ce s, .e., neuroectoderm n or g n

III. DEVELOPMENT OF THE VITREOUS

- 4. eventua y f s the globe and compacts the primary vitreous
  - a. there s a condensed area of v treous that separates the pr mary and secondary v treous
- 5. the secondary vitreous has a condensed area of vitreous at ts per phery
  - a. acts ke an outer sk n

III. DEVELOPMENT OF THE VITREOUS

- C. The tertiary vitreous (zonular fibers) begins to develop at 6 months embryonically
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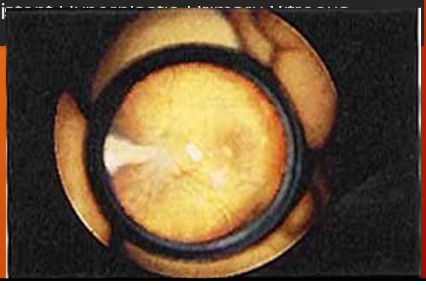
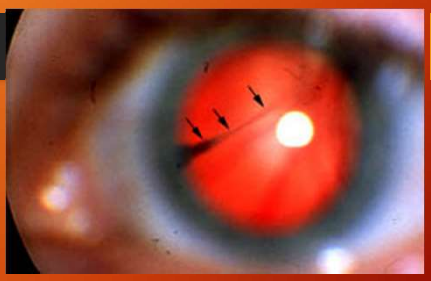
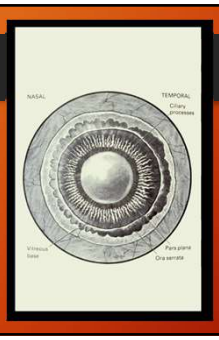




IV. VITREOUS ATTACHMENTS

- A. Anteriorly
  - 1. W eger s Hya o deo Capsular Ligament
  - 2. Ora Serrata (anterior vitreous base)
- B. Posteriorly
  - 1. Opt c Nerve Head (posterior vitreous base)
  - 2. B ood Vesse s of the Retina and the Macula



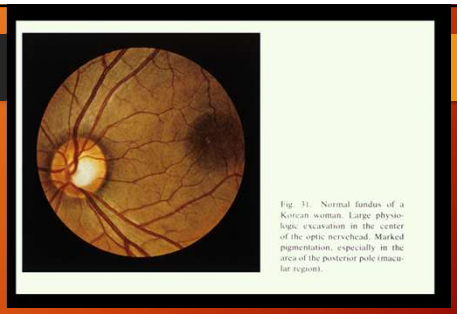


Fig. 31. Normal fundus of a Korean woman. Large physiologic excavation in the center of the optic nervehead. Marked pigmentation, especially in the area of the posterior pole (macular region).

V. CELLS OF THE VITREOUS

- A. Hyalocytes
  - 1. possib y or g nate from monocytes thus not ntr nsic to the vitreous
  - 2. located n the anter or cortical vitreous near the ci iary body
  - 3. have a ha f fe of about a week
  - 4. on y known funct on is to produce hyaluron c acid

VI. BIOCHEMISTRY OF THE VITREOUS

- A. Composition
  - 1. vitreous body
  - 2. vitreous humor
  - 3. co agen g ves the vitreous its substance and the sodium hya uronate provides the viscoe ast city

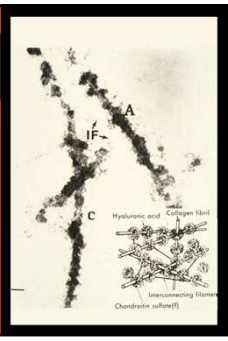
VI. BIOCHEMISTRY OF THE VITREOUS

- B. The human vitreous is typically a gel
  - 1. composed of random y arranged col agen fibers and so ub e hya uronic acid (sod um hya uronate)

Table 9-1. Mucopolysaccharide and collagen content of aqueous humor and vitreous body of various animal species (μg/ml)*

Species	Aqueous humor (mucopolysaccharide)	Vitreous body	
		Mucopolysaccharide	Collagen
Squid (*Loligo pealii*)		230	3.3
Frog (*Rana catesbeiana*)		<1	182
Carp (*Cyprinus carpio*)	591	575	690
Tuna (*Thunnus thynnus*)	880	660	217
Chicken (*Gallus gallus*)	21	21 (17)†	209 (1.5)†
Barred owl (*Strix varia varia*)	262‡ 158§	35	90
Rabbit (*Lepus cuniculus*)	<3	51	104
Guinea pig (*Cavia porcellus*)		37	134
Steer (*Bos taurus*)	<2	710	57
Owl monkey (*Aotus trivirgatus*)	<2	423	25
Human being		240	286

*From Balazs, E. A. Physiology of the vitreous body. In Schepens, C. L., editor: Importance of the vitreous body in retina surgery with special emphasis on reoperations, St. Louis, 1960, The C. V. Mosby Co.
†In liquid portion of vitreous.
‡Next to corneal endothelium.
§Next to lens.



VI. BIOCHEMISTRY OF THE VITREOUS

- C. Collagen
  - 1. the prote n of the vitreous is called vitrosin
    - a. determ ned to be co agen for severa reasons
      - . has he am no ac d hydroxypro ne wh ch s spec f c to co agen
      - . has a shr nkage tempera ure of 60 to 65 degrees cent grade he same as co agen
      - . has the same X ray d ract on proper es as co agen

VI. BIOCHEMISTRY OF THE VITREOUS

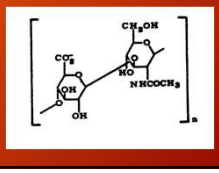
- b. propert es d fferent from co agen
  - . 4% o 9% of the we gh o v ros n s a comp ex po ysacchar de hat can no be separated rom t
  - . The po yacry am de ge e ec rophoret c pa ern of v tros n does not match co agens types I or IV
  - . on y 60% to 93% of the v treous framework can be d sso ved w h co agenase

VI. BIOCHEMISTRY OF THE VITREOUS

- 2. the co agen content of the vitreous is highest where t s a ge , at the vitreous cortex
- 3. there are species d fferences in collagen content
  - a. the h gher the co agen content the h gher the v scos ty of the v treous

VI. BIOCHEMISTRY OF THE VITREOUS

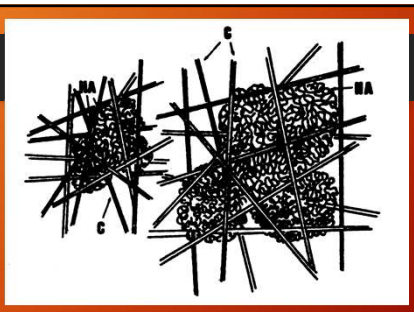
- D. Sodium Hyaluronate
  - 1. a repeat ng chain of disaccharide units made up of N acetyl D g ucosam ne and D g ucuron c acid



- 2. the mo ecu ar we ght is between 10,000 and 1,000,000
- 3. hydroph c n nature
- 4. most concentrated n the cort cal vitreous

VI. BIOCHEMISTRY OF THE VITREOUS

- 5. turnover rate s 0.45 micro grams/ day
- 6. contro s the viscosity of the vitreous
- 7. the qu d portion of the vitreous increases w th age



VI. BIOCHEMISTRY OF THE VITREOUS

- E. Normal Ionic Composition
  - 1. the vitreous, except for collagen and sod um hya uronate, s very sim lar to the aqueous
    - a. Oxygen
      - . the oxygen n the v treous comes from he ar er es of the re na

VI. BIOCHEMISTRY OF THE VITREOUS

- b. Water
  - . the wa er n the v treous s exchanged about every 30 m nu es
  - . wa er movement o 85 mm3 / m n
- c. Sod um
  - . sod um en ers anter or y rom the c ary body and poster or chamber
  - . 90 % o he sod um n the v treous s exchanged n 24 hours ma n y f ows o he aqueous demonstrated w h ntrav trea n ec ons of hot sod um

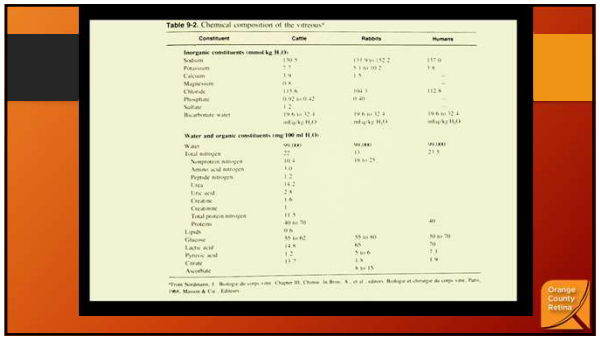


Table 9-2. Chemical composition of the vitreous*

Constituent	Cattle	Rabbits	Humans
Inorganic constituents (mmol/kg H_2O):			
Sodium	130.9	131.9 to 152.2	137.0
Potassium	7.7	5.1 to 10.2	3.8
Calcium	3.8	1.5	—
Magnesium	0.8	—	—
Chloride	115.6	104.1	112.8
Phosphate	0.92 to 0.42	0.40	—
Sulfate	1.2	—	—
Bicarbonate water	19.6 to 32.4 mEq/kg H_2O	19.6 to 32.4 mEq/kg H_2O	19.6 to 32.4 mEq/kg H_2O
Water and organic constituents (mg/100 ml H_2O):			
Water	99.100	99.000	99.000
Total nitrogen	22	13	23.5
Nonprotein nitrogen	10.4	16 to 25	
Amino acid nitrogen	1.0		
Peptide nitrogen	1.2		
Urea	14.2		
Uric acid	2.8		
Creatine	1.6		
Creatinine	1		
Total protein nitrogen	11.5		
Protein	40 to 70		40
Lipids	0.6		
Glucose	55 to 62	55 to 80	30 to 70
Lactic acid	14.8	65	70
Pyruvic acid	1.2	5 to 6	7.3
Citrate	13.7	1.8	1.9
Ascorbate		8 to 15	

*From Nordmann, J.: Biologie du corps vitré. Chapter III, Chimie. In Bron, A., et al., editors: Biologie et chirurgie du corps vitré, Paris, 1968, Masson & Cie., Editeurs.

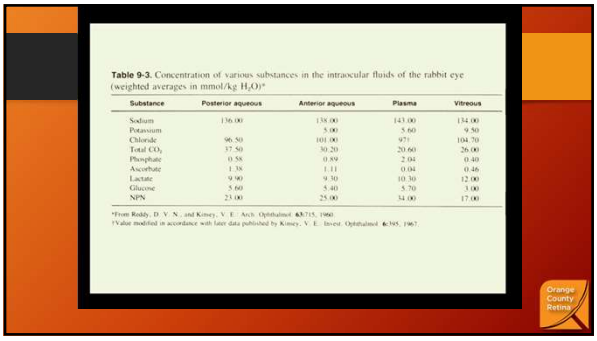


Table 9-3. Concentration of various substances in the intraocular fluids of the rabbit eye (weighted averages in mmol/kg H_2O)*

Substance	Posterior aqueous	Anterior aqueous	Plasma	Vitreous
Sodium	136.00	138.00	143.00	134.00
Potassium		5.00	5.60	9.50
Chloride	96.50	101.00	97†	104.70
Total CO_2	37.50	30.20	20.60	26.00
Phosphate	0.58	0.89	2.04	0.40
Ascorbate	1.38	1.11	0.04	0.46
Lactate	9.90	9.30	10.30	12.00
Glucose	5.60	5.40	5.70	3.00
NPN	23.00	25.00	34.00	17.00

*From Reddy, D. V. N., and Kinsey, V. E.: Arch. Ophthalmol. **63**:715, 1960.
†Value modified in accordance with later data published by Kinsey, V. E.: Invest. Ophthalmol. **6**:395, 1967.

VI. BIOCHEMISTRY OF THE VITREOUS

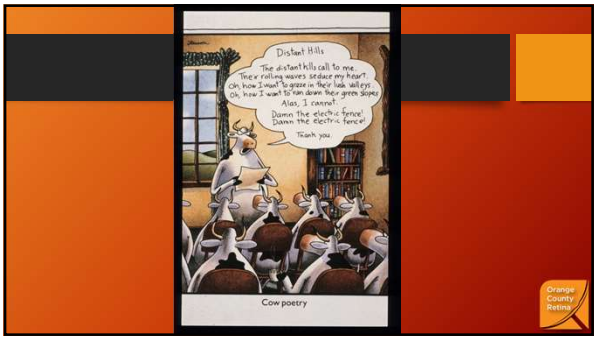
- d. Potass um
  - . enters by act ve transpor hrough the c ary ep the um n o he poster or chamber
  - . d fluses nto the v treous rom ens and pos er or chamber
  - . ex s hrough the ret na
- e. Ch or de
  - . there s a grad ent o ch or de from the v reous to the aqueous
  - . ch or de removed v a he re na and the pos er or chamber

VI. BIOCHEMISTRY OF THE VITREOUS

- f. Phosphate
  - . enters he v treous v a he c ary body
  - . ow concentrat on n he v reous because s used by the re na
  - . f re na damaged, concen rat on of phosphate goes up n v reous
- g. G ucose
  - . g ucose d f uses nto the v treous from a ssues, pr nc pa y the ret na
  - . due to v scos ty of v reous, d fus on n o v reous s ower han nto aqueous

VI. BIOCHEMISTRY OF THE VITREOUS

- h. Prote ns
  - . the b ood v trea barr er b ocks the movemen of most pro e ns nto the v treous



VI. BIOCHEMISTRY OF THE VITREOUS

- F. The Blood Vitreal Barrier
  - 1. a specif c b ood vitreal barrier has been inferred from the many mo ecules that have d fferent concentrations in the vitreous and the aqueous (thus not ust an aqueous extract)
  - 2. few mo ecu es penetrate the vitreous, **small molecules penetrate better than large ones.**

VI. BIOCHEMISTRY OF THE VITREOUS

- a. F uoresce n
  - . ntra v rea n ect ons demonstrate tha the b ood v trea barr er s 27 to 38 mes more permeab e n the ou ward d rect on han he nward d rec on for f uoresce n
- b. Ant b ot cs
  - . mos an b ot cs do not have good pene ra on nto the v reous
  - . add ona y when they are n ected nto the v reous they are read y **removed by a carrier mechanism**

Table 9-5. Penetration of various compounds from the blood into the aqueous humor and the vitreous body of the rabbit eye*

Compound	Lipoid solubility	Molecular weight	Blood	Concentration ratio		
				Aqueous	Vitreous	C_V/C_A
Dyes						
Fluorescein	0.18	332	1	0.030	<0.005	<0.17
Phenolsulfonphthalein	0.0008	354	1	0.05	<0.005	<0.1
Rhodamine B	23	428	1	0.40	0.40	1.0
Antibiotics						
Penicillin	0.0004	334	1	0.15	0.002	0.01
Phenoxyethylpenicillin	0.0004	365	1	0.02	<0.002	0.1
Dimethoxyphenylpenicillin	0.0003	380	1	<0.02	<0.002	0.1
Diethylaminoethylpenicillin (penethamate)	0.025	443	1	0.1	0.1	1.0
p-Aminohippuric acid	0.004	194	1	0.38	0.02	0.05
p-Aminohippuric ethylester	0.33	223	1	0.46	0.27	0.59
Streptomycin	Negligible	581	1	<0.05	<0.05	—
Chlortetracycline	Negligible	423	1	<0.05	<0.05	—
Oxytetracycline	Negligible	441	1	<0.05	<0.05	—
Chloramphenicol	4	323	1	0.4	0.4	1.0
Other substances						
Acetazolamide	0.06	222	1	—	Negligible	—
Urea	<0.0006	60	1	0.90	0.74	0.92
Glucose	<0.0004	180	1	0.9	0.5	0.6
Sucrose	<0.0004	342	1	Moderate	Negligible	—

*After Bloeker, G. M., et al.: Exp. Eye Res. 7:37, 1968.

VI. BIOCHEMISTRY OF THE VITREOUS

- . the carr er mechan sm may be nh b ted w h he s mu aneous n ect on of probenec d
- v. **penetrat on** nto the v reous appears o be **related to the posolubility** o he compound
  - 1 ch oramphen co s h gh y p d so ub e and penetrates he v treous rom he b ood s ream we so hat therapeut c doses are ach eved

Summary: Blood Vitreous Barrier

- Active pump to remove substances in retinal vessels, RPE, and ciliary epithelium
- Lipid soluble substances have high permeability
- Mechanical barrier
  - vitreous meshwork

Blood Aqueous Barrier

- Mechanical Barrier
  - vascu ar endothe um, RPE, cil ary body ep thelium

BIOCHEMISTRY OF THE VITREOUS

- G. Metabolism
  - 1. only the hyaluronocytes exhibit metabolic activity
    - a. principal product of sodium hyaluronate
    - b. if a the hyaluronate is removed with an intravitreal injection of hyaluronidase it will be totally reformed in 6 weeks

VII. PATHOLOGY AND AGE RELATED CHANGES

- A. Aging Changes
  - 1. Syneresis
    - a. a breakdown of the vitreous gel
    - b. fluid filled cavities form
    - c. 65 % of those over the age of 60 have syneresis
    - d. higher incidence in myopes

VII. PATHOLOGY AND AGE RELATED CHANGES

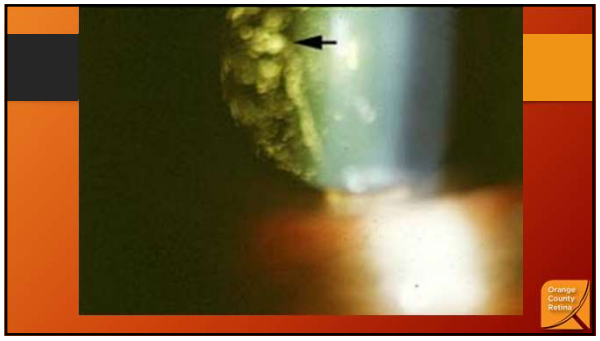
- e. results in the fluid filled cavities enlarging and a possibility of the vitreous detaching from the retina
- f. with detachment the patient reports flashing lights and floaters
- g. more prone to retinal detachment

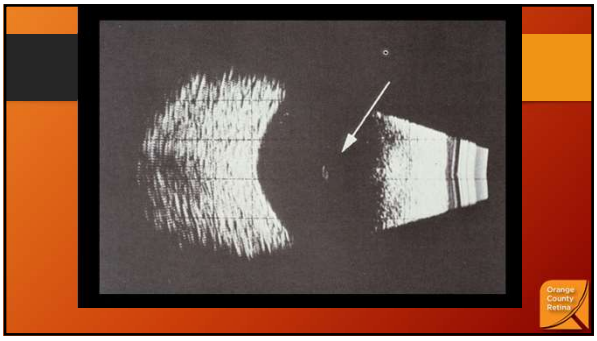
VII. PATHOLOGY AND AGE RELATED CHANGES

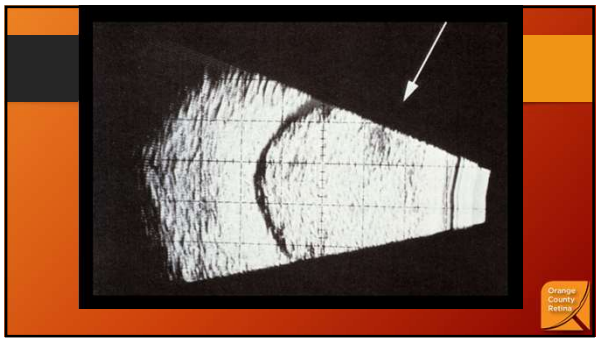
- 2. Asteroid Hyalosis
  - a. hundreds of small spheres of calcium soaps are seen in the vitreous
  - b. are attached to the fibers of the vitreous so they move when the eye moves but always return to the same position
  - c. not associated with any systemic condition

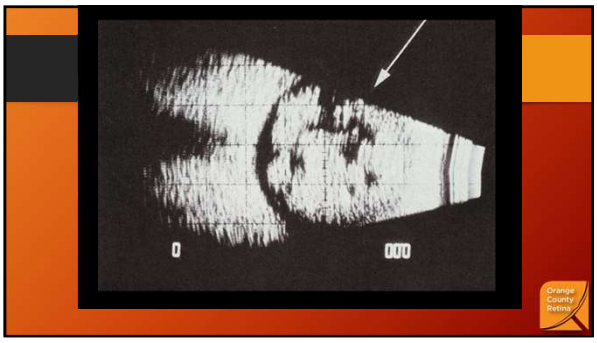
VII. PATHOLOGY AND AGE RELATED CHANGES

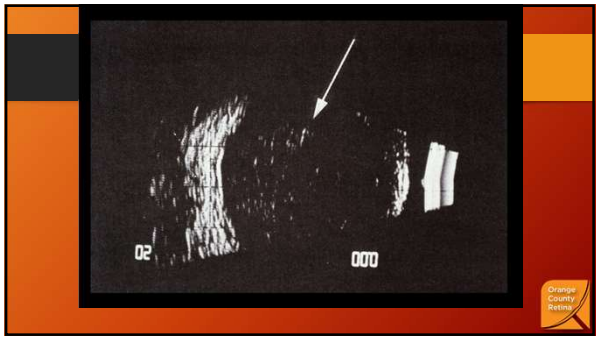
- d. more common in the elderly
- e. no clinical significance
- f. does not effect vision
- g. 3 times more likely to be unilateral than bilateral







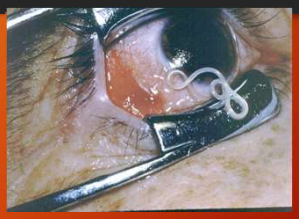




VII. PATHOLOGY AND AGE RELATED CHANGES

- 3. Synchysis Scint ans
  - a. usua y b atera
  - b. cho estero crysta s n the v treous that are not attached
  - c. not assoc ated w th any system c cond t on
  - d. no oss of v s on
  - e. usua y occurs before 40

Loa Loa Worm



VII. PATHOLOGY AND AGE RELATED CHANGES

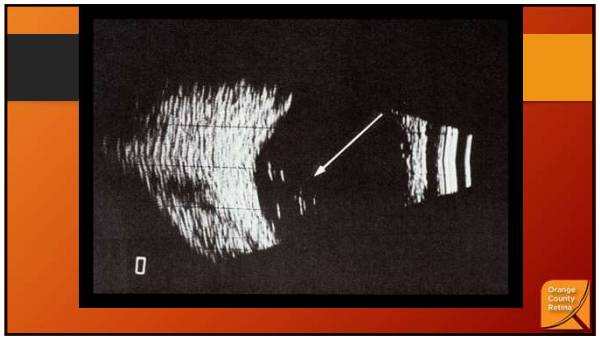
- B. Vitreous Inflammations
  - 1. Endophtha m t s
    - a. pa nfu cond t on assoc ated w th photophob a, redness and edema of the con unct va and ds
    - b. rare
    - c. usua y caused by a penetrat ng n ury that ntroduces Bac us subt s (found n the so) nto the v treous
    - d. nfect on usua y destroys the eye, even w th the adm n strat on of ant b ot cs

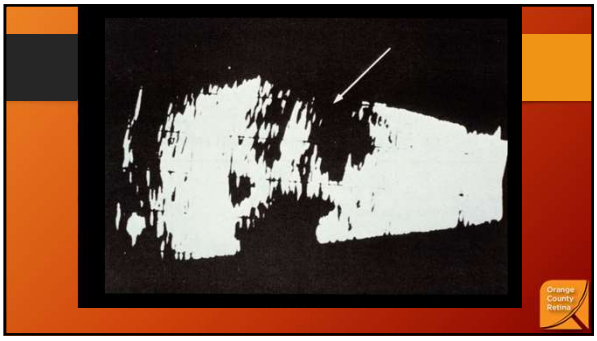
Nail In The Vitreous

Viruses
- CMV
- HSV
- VZV
- EBV
- HTLV-1
- Adenovirus
- Human herpes virus-8

Protozoa
- Toxoplasma gondii
- Onchocecra volvulus

Bacteria and fungi
- Streptococcus
- Staphylococcus
- Pseudomonas
- P. acnes
- Mycobacterium spp
- Borrelia burgdorferi
- Bartonella spp
- Tropheryma whippeli
- Candida albigans
- Aspergillus





VII. PATHOLOGY AND AGE RELATED CHANGES

- 2. Secondary Inf ammations
  - a. the ma or ty of v trea nf ammat ons are secondary to nf ammat ons of the choro d or ret na
  - b. resu t n wh te b ood ce s n the v treous that cause b urr ng of the ret na and decrease n v s on
  - c. genera y reso ves when the pr mary nfect on s treated
  - d. f v treous does not c ear may need to perform v trectomy

Active Toxoplasmosis

VII. PATHOLOGY AND AGE RELATED CHANGES

- 3. Hemorrhage
  - a. can be m n ma or the ent re v treous can be fu
  - b. can resu t from trauma, d abetes, HBP or b ood dyscras as, .e., eukem a
  - c. the treatment depends on the pr mary cause of the hemorrhage
    - . may ust o ow or may need a v trectomy

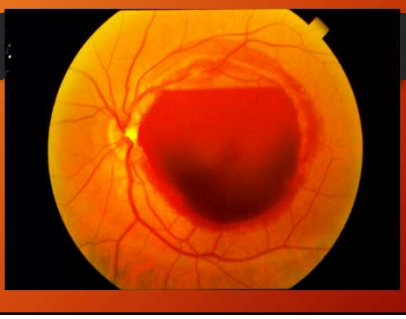


Fig. 119. Proliferative retinopathy in diabetes. Hemorrhages, neovascularization, and preretinal strands.

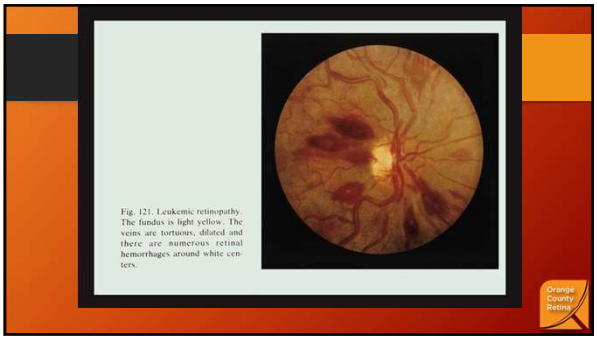
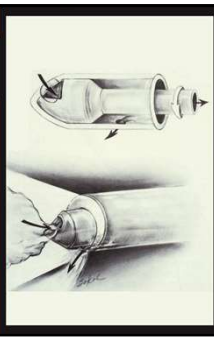
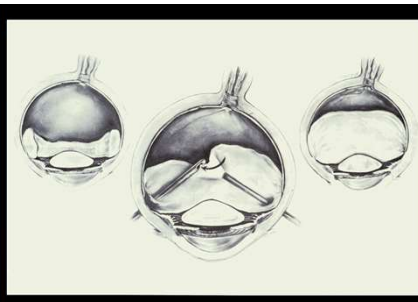


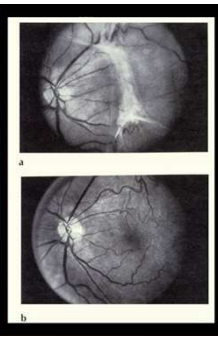
Fig. 121. Leukemic retinopathy. The fundus is light yellow. The veins are tortuous, dilated and there are numerous retinal hemorrhages around white centers.

VII. PATHOLOGY AND AGE RELATED CHANGES

- C. Vitrectomy
  - 1. th s surg ca procedure was not performed unt the 1970's
  - 2. ncision made n pars plana
  - 3. m cro surg cal instrument inserted
    - a. takes up a sma p ece of v treous, cuts t, removes t and then rep aces w th an equa vo ume of sa ne

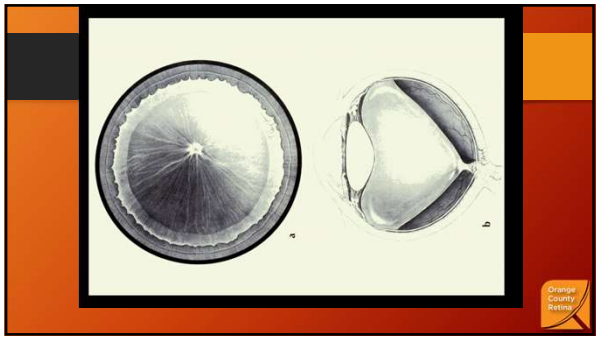


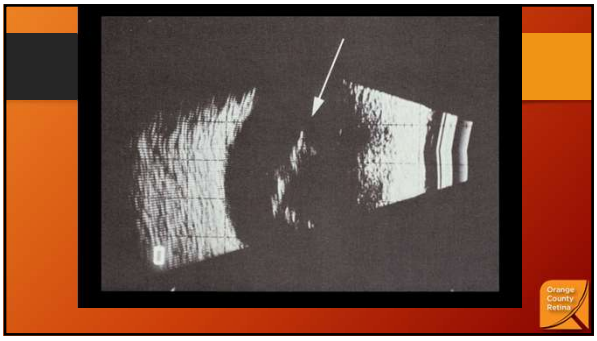


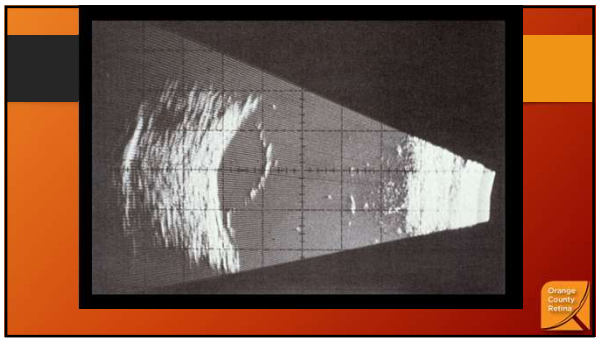


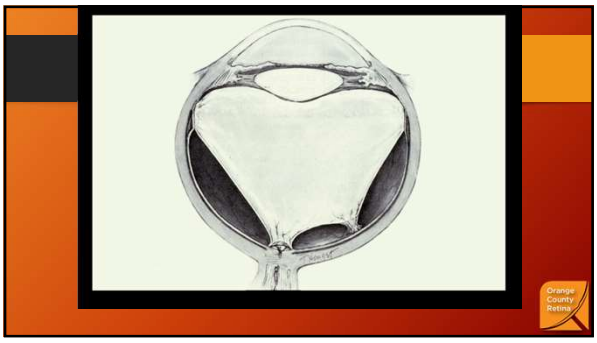
a

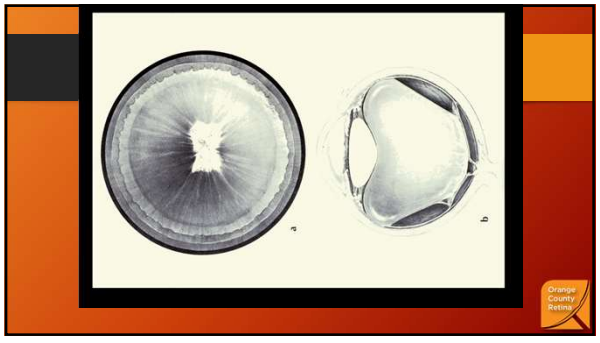
b

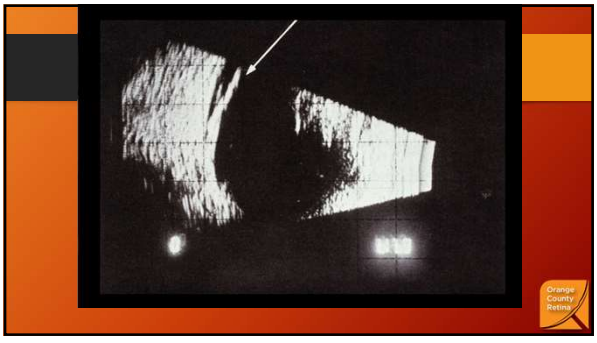


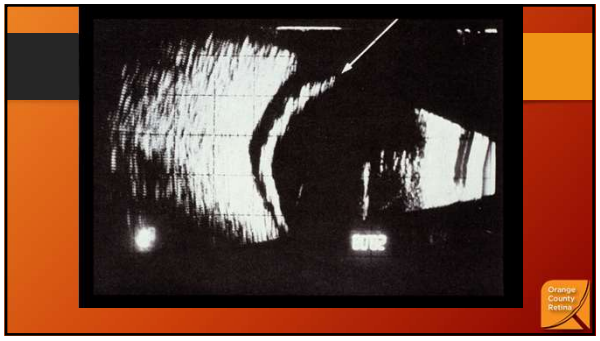











Orange
County
Retina

CURRICULUM VITAE

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Orange County, California
Physician/Surgeon
Since July 2012

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Ophthalmology
Washington University School of Medicine / Barnes-Jewish Hospital
St. Louis, Missouri; 2006-2009

Internship in Medicine
Santa Clara Valley Medical Center Transitional Internship
Stanford University School of Medicine
San Jose, California; 2005-2006

Medical School
Medical Doctorate
Vanderbilt University School of Medicine
Nashville, Tennessee; 2000-2005

Graduate
Master of Business Administration
Owen Graduate School of Management
Vanderbilt University
Nashville, Tennessee; 2003-2005

Undergraduate
Bachelor of Science, Biological Sciences
Stanford University
Stanford, California; 1995-1999

BOARD CERTIFICATION

American Board of Ophthalmology, Diplomate 2012
United States Medical Licensing Examination, Diplomate 2006

MEDICAL LICENSURE

California, issued 2012
Illinois, through 7/31/14
Missouri, through 1/31/11

HONORS

2011 Fellow of the Year Award, University of Illinois at Chicago
2010 "Golden Apple" Best Teacher Award, Washington University
2009 Mat Guirgis Pediatric Opthalmology & Strabismus Award: Outstanding Resident, Washington University
2009 Ron Burde Award (dedication to taching and patient care), Washington University
2008 CareerPhysician Chief Resident Program Competition Winner
2005 Beta Gamma Sigma, Vanderbilt Chapter
2004 Tulane Business Plan Competition, Second Place
2001 Microbes and Defense Society, Vanderbilt University
2001 Top Spear Award (top student in physiology course), Vanderbilt University

PROFESSIONAL ORGANIZATIONS

American Academy of Ophthalmology
American Medical Association
Chicago Ophthalmological Society
Missouri Society of Eye Physicians and Surgeons
St. Louis Ophthalmological Society

HOSPITAL/SURGERY CENTER AFFILIATIONS

2012 – Present	Anaheim Regional Medical Center, Anaheim, California
2012 – Present	Barranca Surgery Center, Irvine, California
2012 – Present	Children's Hospital of Orange County, Orange, California
2012 – Present	Children's Hospital at Mission, Mission Viejo, California
2012 – Present	Hoag Memorial Hospital Presbyterian, Newport Beach, California
2012 – Present	Pacifica Hills Surgery Center, Laguna Hills, California
2012 – Present	St. Joseph Hospital, Orange, California
2012 – Present	St. Jude Medical Center, Fullerton, California
2012 – Present	Western Medical Center, Santa Ana, California

CLINICAL RESEARCH

Six years of experience, prior to July 2012, in conducting research in ophthalmology-related topics including endophthalmitis, vitreoretinal surgery, retinal detachment repair, and sickle cell retinopathy.

01. Lpath, Protocol LT1009-Oph-003 (NEXUS), Phase IIA, 2012-Present
Sub-Investigator. *A multicenter, masked, randomized, comparator-controlled study evaluation Isonep™ (sonepcizumab [LT1009]) as either monotherapy or adjunctive therapy to Lucentis or Avastin versus Lucentis or Avastin alone for the treatment of subjects with choroidal neovascularization secondary to AMD.*

02. Alimera Sciences, Protocol C-01-11-008, Extension Study, 2012-Present
Sub-Investigator. *An open-label, multicenter, extension study of the safety and utility of the new inserter of Iluvien® (Fluocinolone Acetonide Intravitreal Insert) 0.19mg and the safety of Iluvien® in subjects with DME.*

03. EyeGate Pharmaceuticals, Protocol EGP-437-004, Phase III, 2012-2013
Sub-Investigator. *A prospective, multi-center, randomized, double-masked, positive controlled, clinical trial designed to evaluate the safety and efficacy of iontophoretic dexamethasone phosphate ophthalmic suspension (1%) in patients with non-infectious anterior segment uveitis*

04. Quark Pharmaceuticals, Protocol QRK202 (MATISSE), Phase II, 2012-Present
Sub-Investigator. *An open-label dose escalation study of PF-04523655 (Stratum I) combined with a prospective, randomized, double-masked, multi-center, controlled study (Stratum II) evaluating the efficacy and safety of PF-04523655 alone and in combination with ranibizumab versus ranibizumab alone in diabetic macular edema*

05. Xoma, Protocol X052130/CL3-78989-005, Phase III, 2012-Present
Sub-Investigator. *A randomized, double-masked, placebo-controlled study of the safety and efficacy of gevokizumab in the treatement of active non-infectious intermediate, posterior, or pan-uveitis*

06. Pfizer, Protocol B1181003-1050, Phase II, 2012-Present
Sub-Investigator. *A phase 2, multi-center, randomized, double-masked, placebo-controlled, multi-dose study to investigate the efficacy, safety, pharmacokinetics and pharmacodynamics of RN6G (PF-04382923) in subjects with geographic atrophy secondary to age-related macular degeneration*

07. Xoma, Protocol X052131/CL3-78989-005 (EYEGUARD™ -C), Phase III, 2012-Present
Sub-Investigator. *A randomized, double-masked, placebo-controlled study of the safety and efficacy of gevokizumab in the treatment of subjects with non-infectious intermediate, posterior, or pan- uveitis currently controlled with systemic treatment*

08. Regeneron Protocol VGFTe-AMD-1124 ((RE-VIEW), Phase IV, 2012-Present
Sub-Investigator. *Rigorous evaluation of vision and safety with intravitreal afliberecept injection dosed every 8 weeks over 2 years in neovascular AMD*

09. Merck Protocol MK8931—017 (SCH 900931, P07738), Phase 2/3, Collaborative Study, 2012-Present
Ophthalmology Investigator. *A randomized, placebo controlled, parallel-group, double blind efficacy and safety trial of MK-8931 in subjects with mild to moderate Alzheimer's disease*

BIBLIOGRAPHY

ARTICLES

01. **Rathod RR**, Mieler WF. An update on the management of intraocular foreign bodies. *Retinal Physician*; April 2011.

PUBLISHED ABSTRACTS/POSTER PRESENTATIONS

01. **Rathod RR**, Shen DJ, Wang MX. Relationship between stromal ablation depth and hyperopic shift after 6 mm phototherapeutic keratectomy using VISX Star Excimer Laser. *Investigative Ophthalmology and Visual Science* 2002;43:E-Abstract 159.

02. **Rathod RR**, Wang MX, Cohen I. Effects of posterior corneal refractive power change on LASIK; June 2002. American Society of Cataract and Refractive Surgery

03. **Rathod RR**, Khanifar A, Kammer JA. Incidence of glaucoma after repeat penetrating keratoplasty. *Investigative Ophthalmology and Visual Science* 2005;46: E-Abstract 130.

04. **Rathod RR**, Apte RS, Blinder KJ. Safety and outcomes of 25-gauge transconjunctival vitreoretinal surgery. *Investigative Ophthalmology and Visual Science* 2008;49: E-Abstract 6002.

05. **Rathod RR**, Rao PK. Incidence of intraocular infection in the setting of systemic fungal infection. *Investigative Ophthalmology and Visual Science* 2009;50: E-Abstract 3554.

06. **Rathod RR**, Lim JI. Outcomes of retinal detachment repair with relaxing retinectomies in cases of severe proliferative vitreoretinopathy. *Investigative Ophthalmology and Visual Science* 2011;52: E-Abstract 6170.

07. **Rathod RR**, Lim JI. The utility of relaxing retinectomies in repair of recurrent retinal detachments with severe proliferative vitreoretinopathy. Presented as poster at American Society of Retina Specialists Meeting; August 2011.

PRESENTATIONS

01. The role of submacular surgery in the treatment of choroidal neovascular membranes in POHS. Washington University Department of Ophthalmology and Visual Sciences, Grand Rounds; January 31, 2007

02. Posterior reversible encephalopathy syndrome. Washington University Department of Ophthalmology and Visual Sciences, Grand Rounds; February 21, 2007.

03. Functional visual loss. Washington University Department of Ophthalmology and Visual Sciences, Grand Rounds; March 27, 2007.

04. Iontopheretic Dexamethasone Phosphate Opthalmic Suspension in Patients with Non-Infectious Anterior Segment Uveitis: Phase I/II Data. Anaheim, California; October 3, 2012

COMMUNITY INVOLVEMENT

Mobile Eye Care Clinic for the Homeless, Illumination Foundation, Saddelback Memorial Care Hospital, San Clemente, CA; November 4, 2012

LANGUAGES

Medical Spanish, Gujarati