

Color Eye Model Progress and Discussion



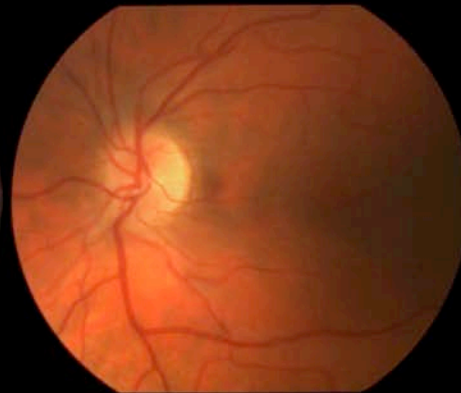
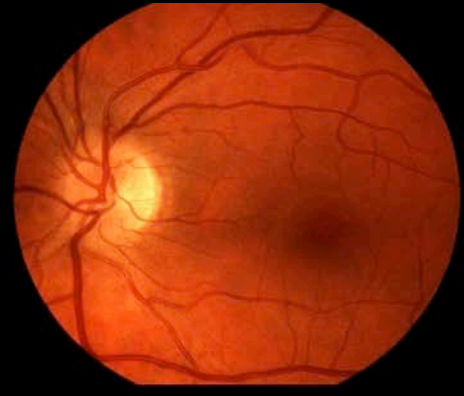
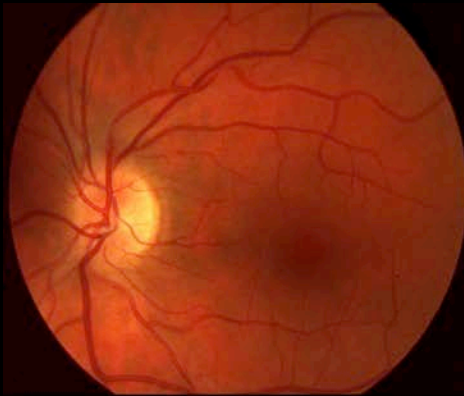
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Associate Professor

Ronald and Mabel Francis Endowed Chair,
Program Chair: Photographic Sciences

School of Photographic Arts and Sciences

Image Variables



Imaging Procedure

- Iris dilated pharmaceutically
- Once dilated, patient aligned in fundus camera headrest
- Photographer adjusts working distance for optimal illumination, focus
- Photograph taken using flash

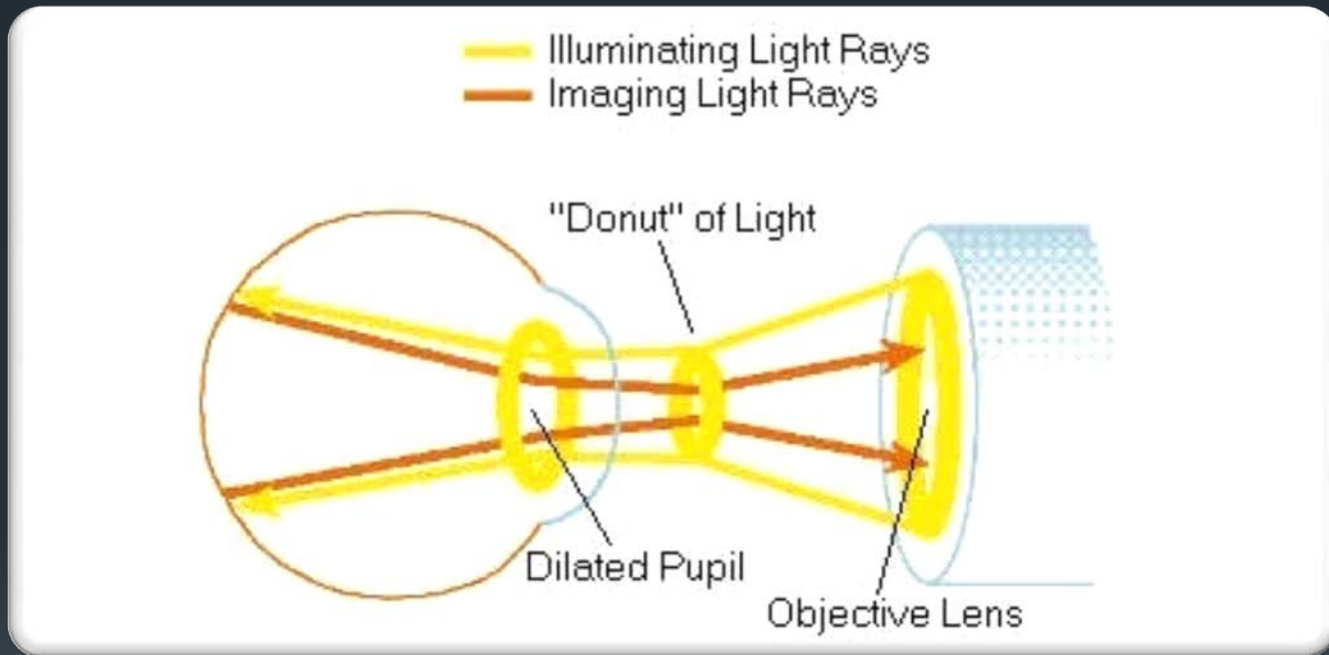


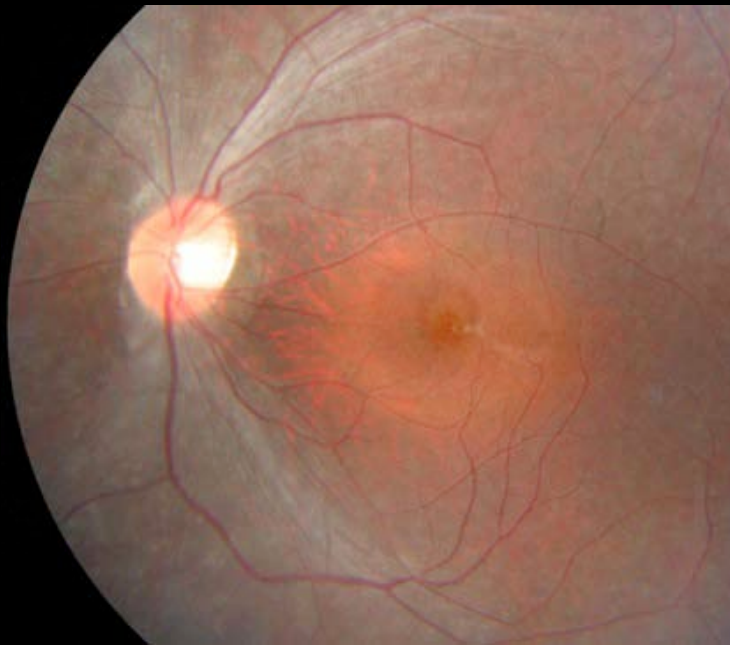
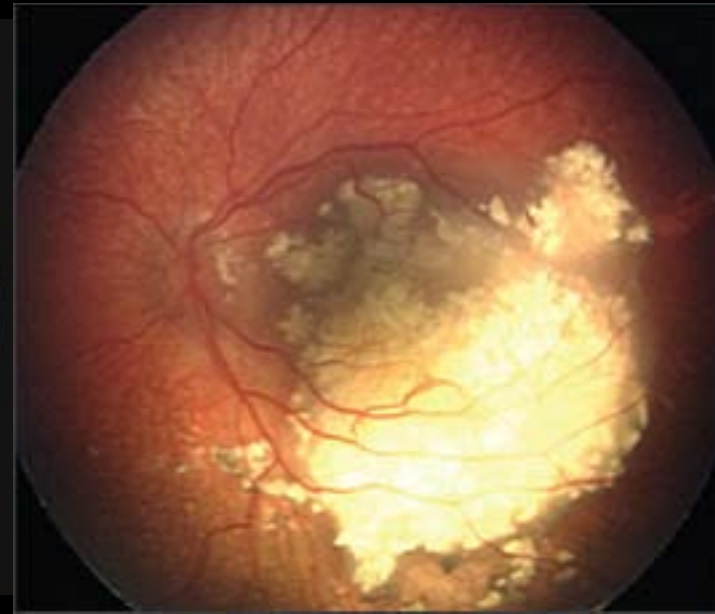
Imaging Procedure

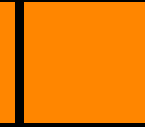
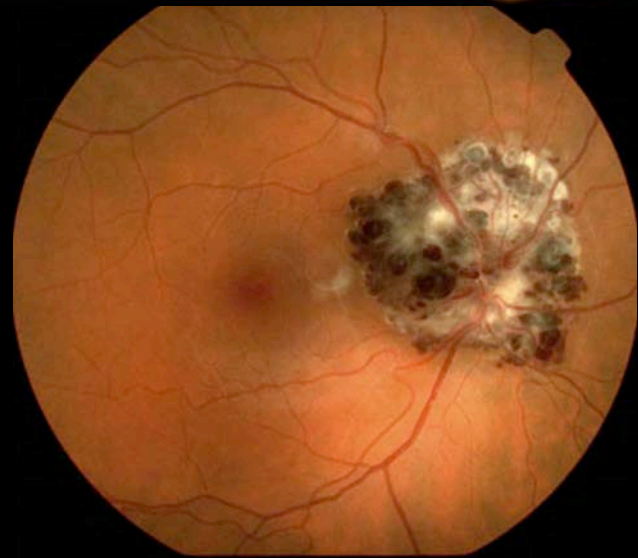
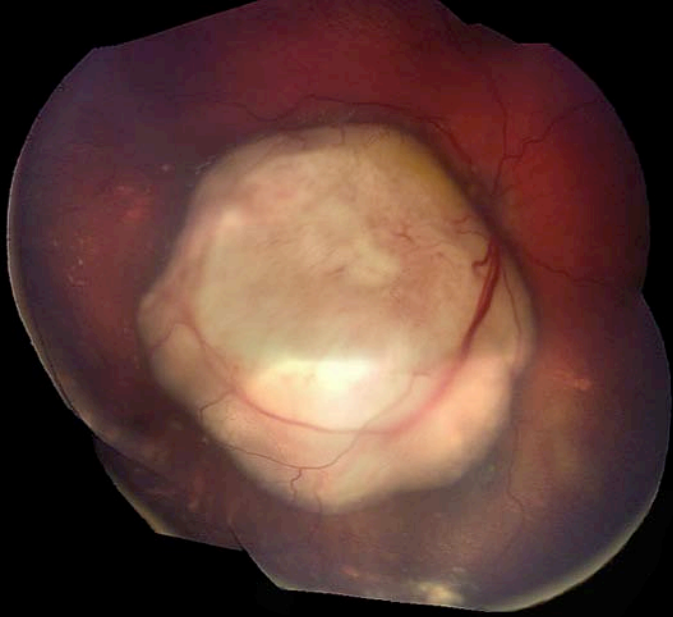
- Iris **dilated** pharmaceutically
- Once dilated, patient **aligned** in fundus camera headrest
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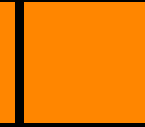
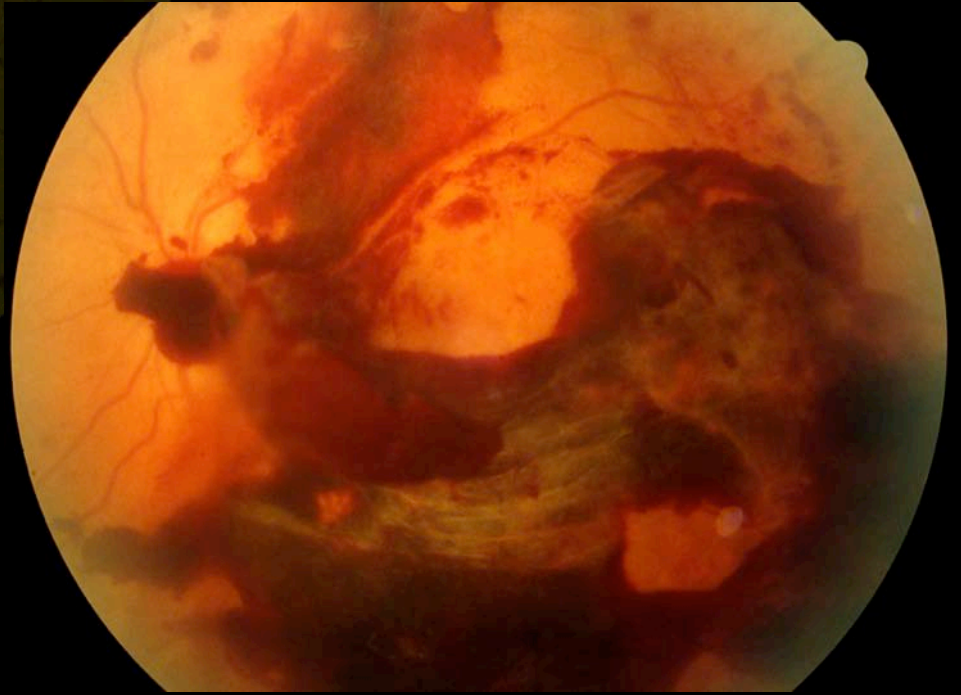
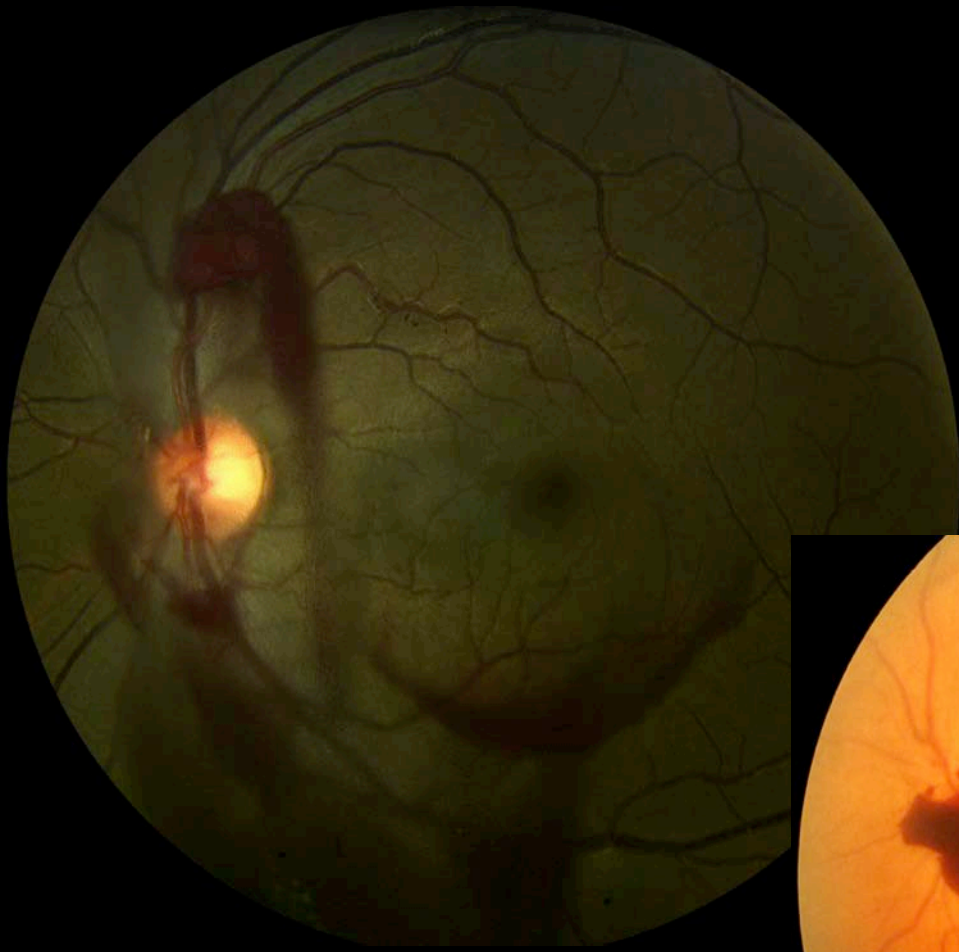


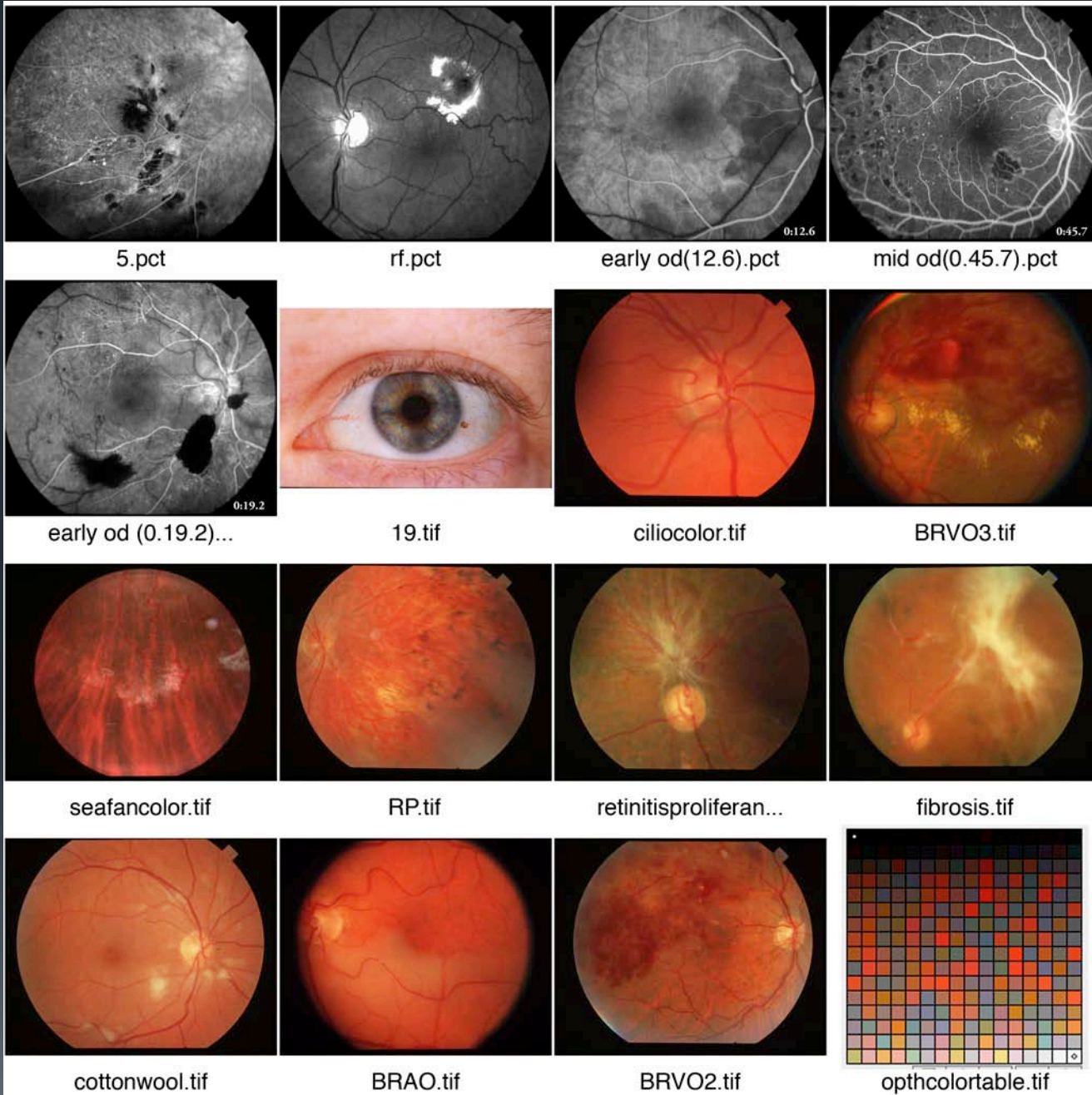
Eye as other half of optical system





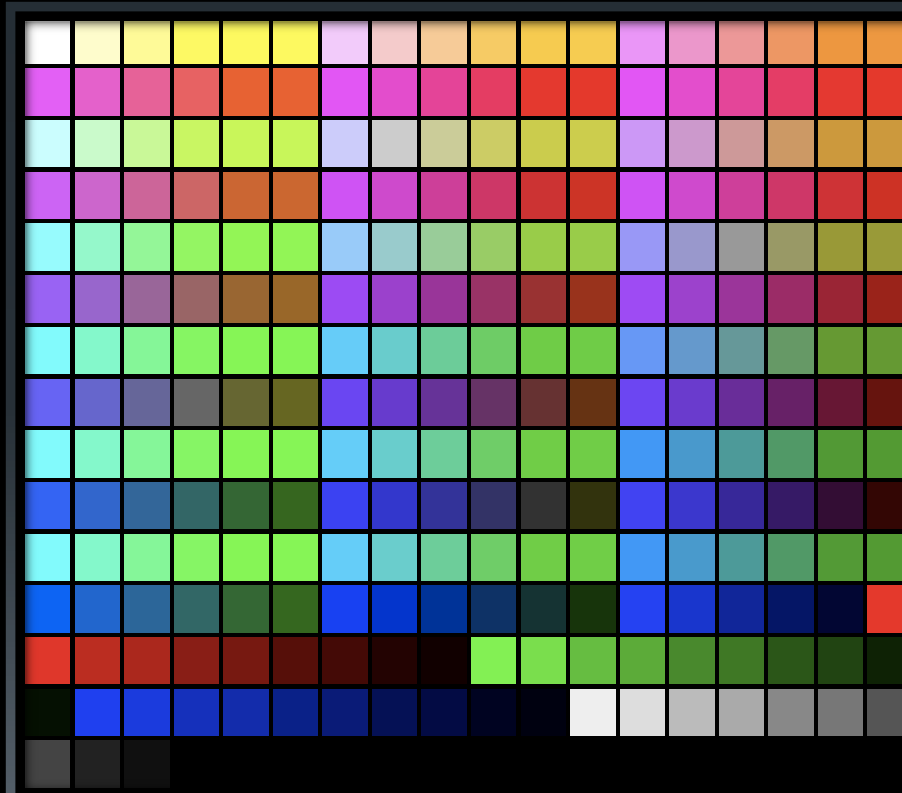




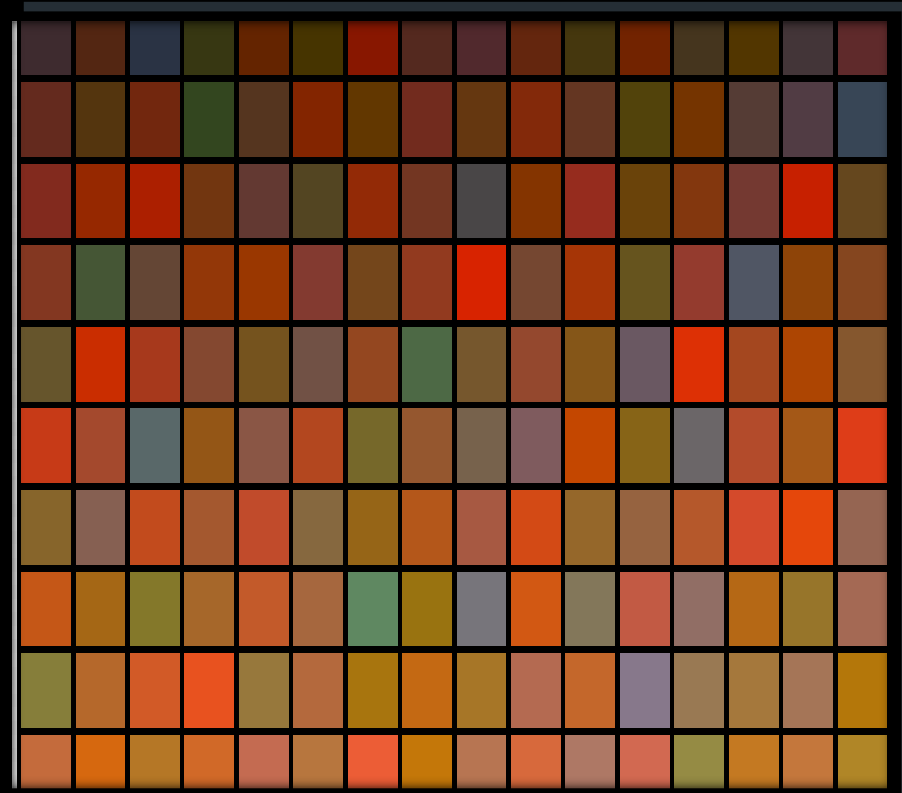


CCD Color: Normal subject vs. retinal subject

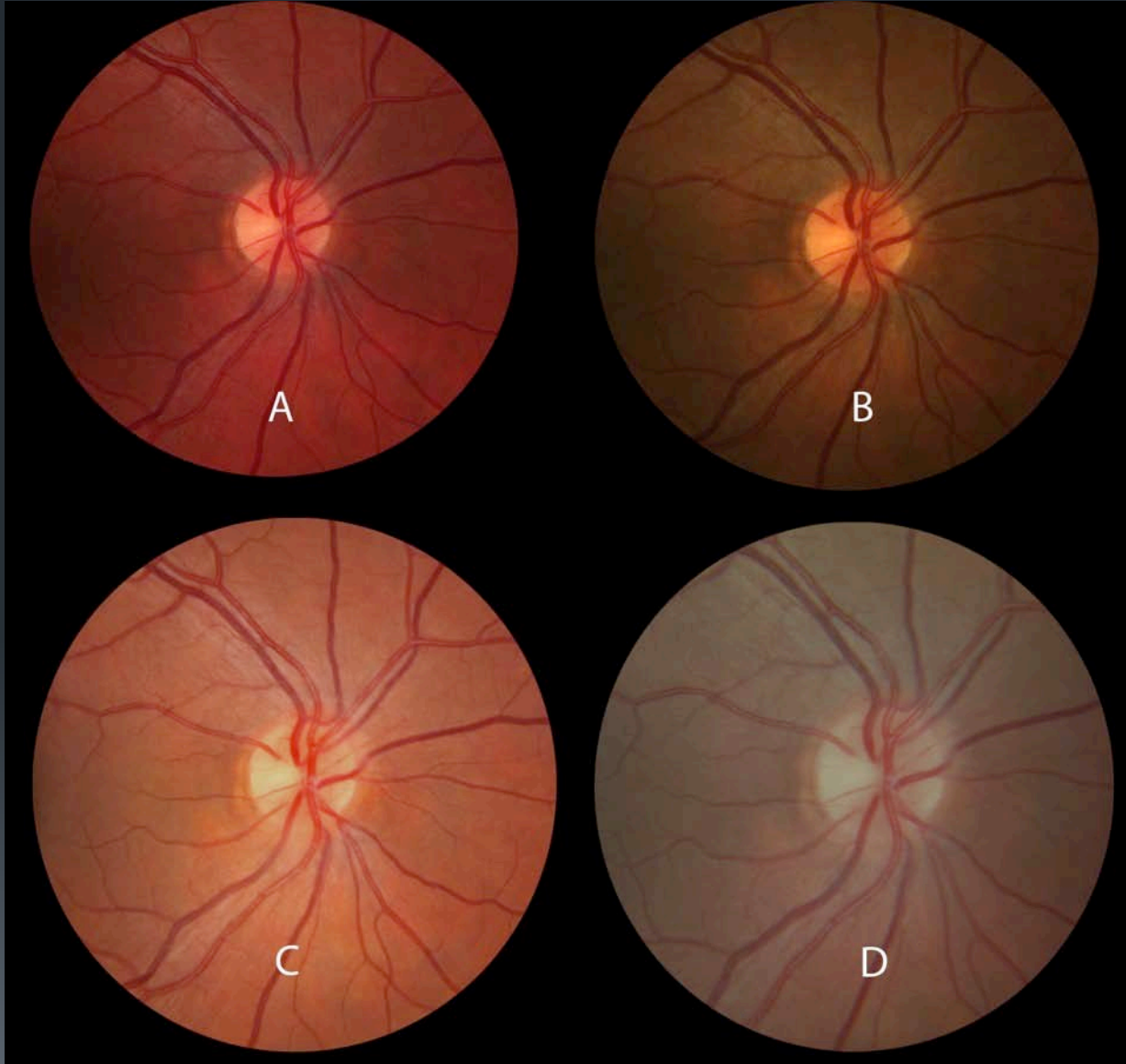
Standard colors



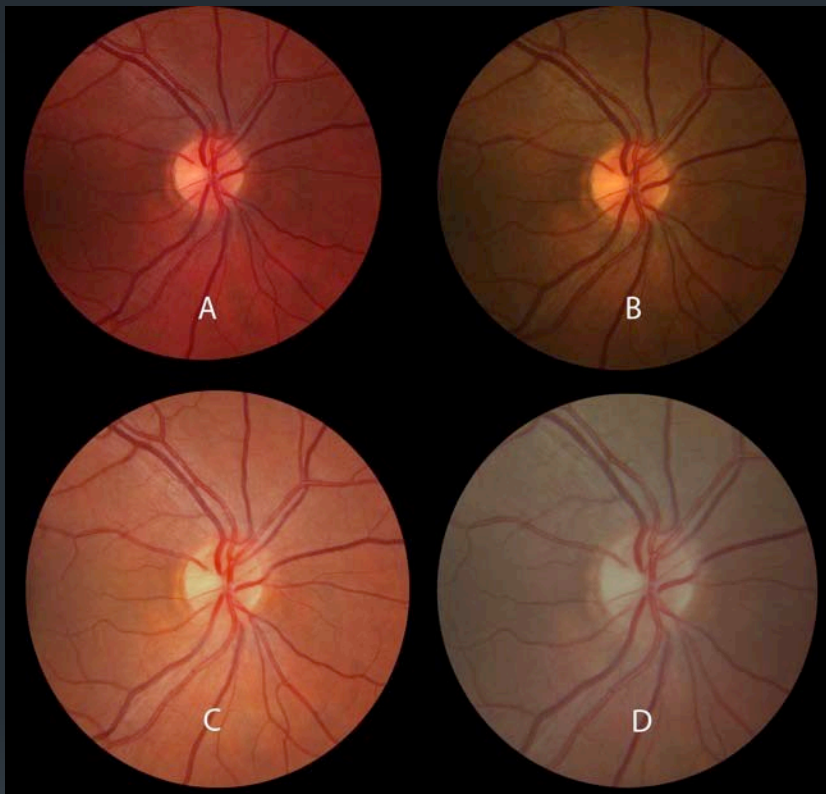
Retinal colors



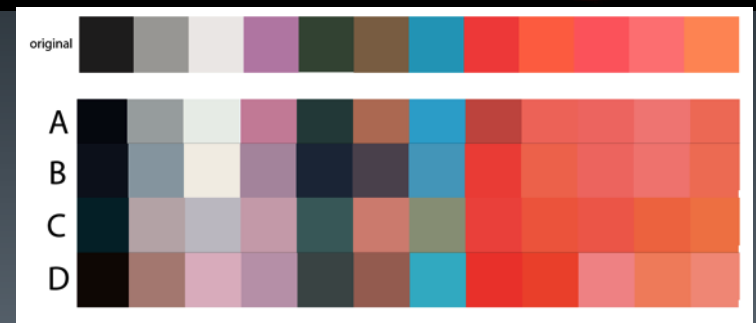
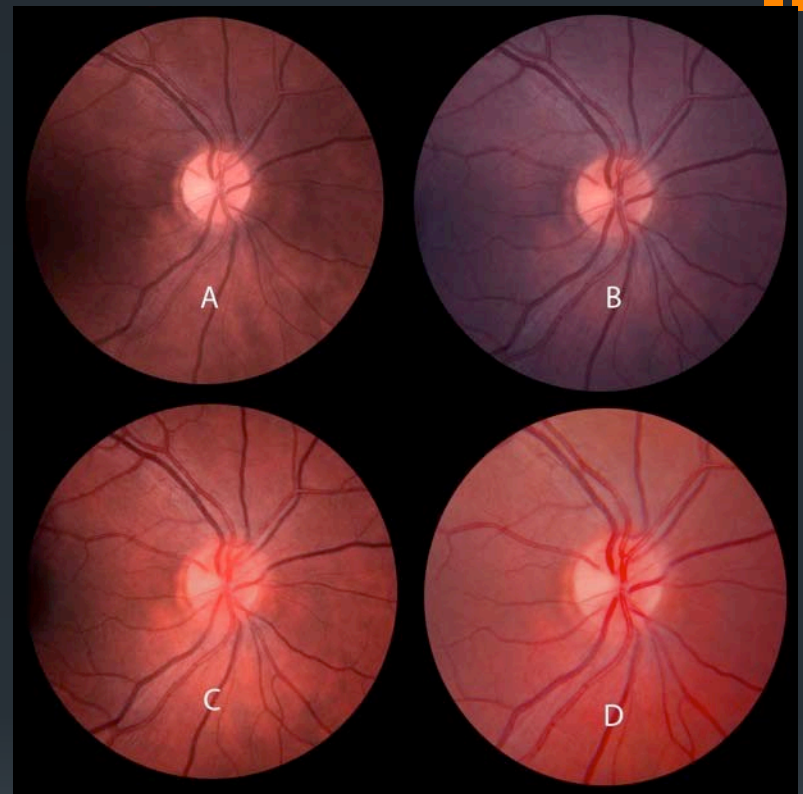
Camera Testing: Phase I



Captured vs. Processed



Before



After



Phase I: Conclusions

- It is potentially possible to profile a fundus camera, at least individually
 - Applying to RAW image in system would be ideal
- *What we as ophthalmic imagers and practitioners believe to be “correct” retinal color is not correct at all*
- A standard approach to color calibration is needed to mitigate input variables

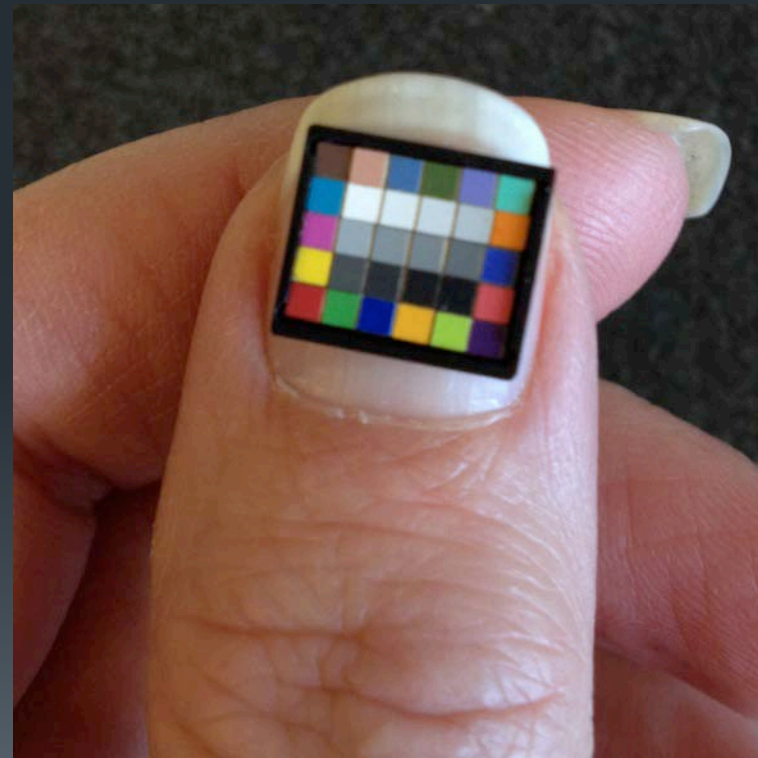


Color Model Eye Project (MIWG) : Phase II

- Determine minimum color patch size
- Refine testing materials
 - Use of a standard color checker
 - Use of a aspherical model eye
- Determine and refine imaging protocol
- Analyze results on TIFF vs RAW

A Better Target (A really, really, really tiny Color Checker)

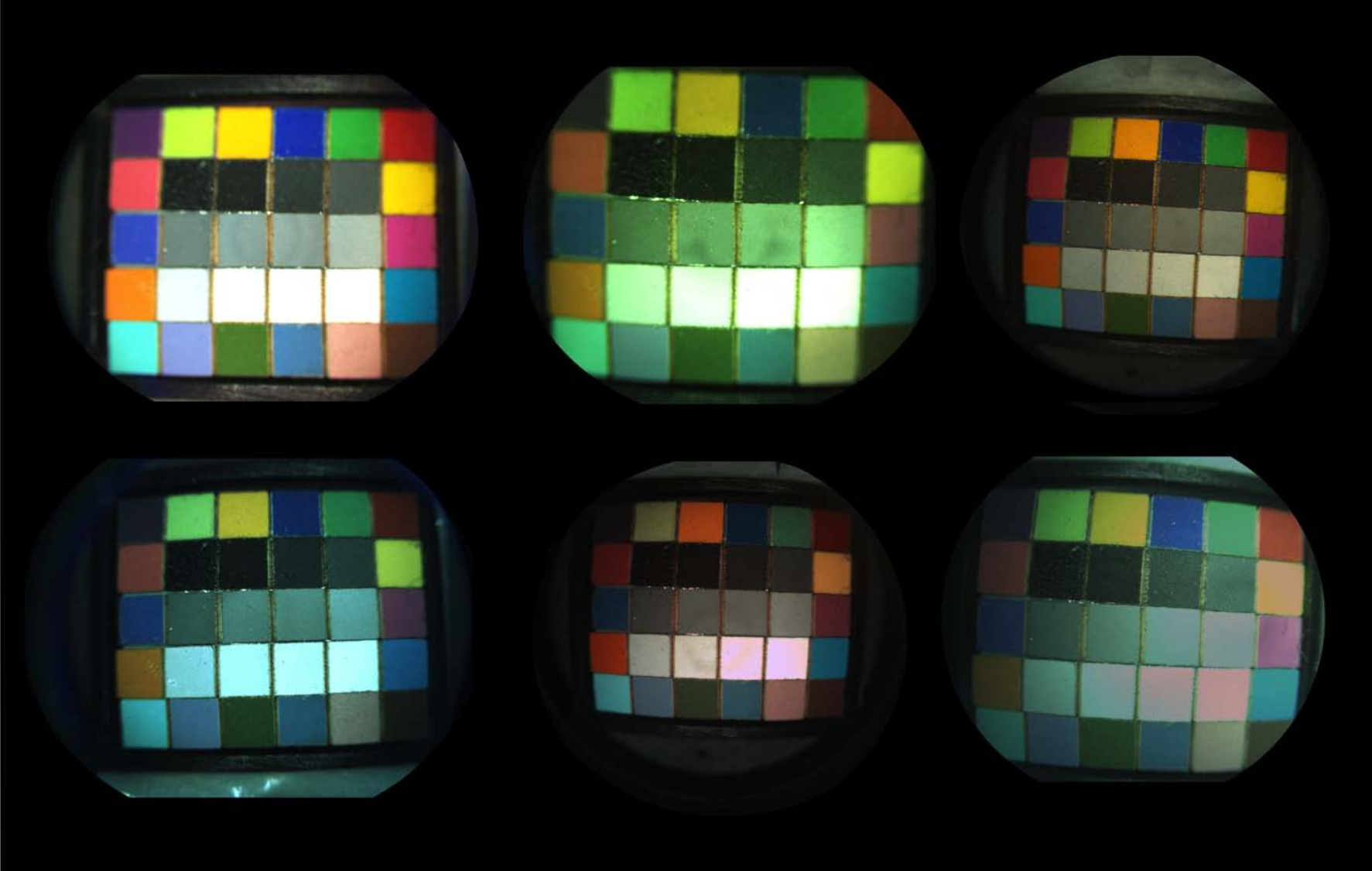
- Identical color patches to GretagMacbeth™ ColorChecker®, 1/12th original size
- Pigmented, painted samples
- Flat field



Protocol

- Inserted test target into model eye
- Chose “middle” angle of view
- Established proper alignment/working distance/focus
- Reduced/eliminate viewing illumination
- Captured at “normal” exposure, +/-







Findings and Discussion

- Illumination/exposure ratio issue
- What impact does field of view have? Flat field?
- Colors of target?
- Color of the inside of model eye?
- RAW vs. exported TIFF?
- Implementation?



Illumination/Flash Exposure

- Illumination influences final flash exposure depending on brightness of illumination and flash setting (watt-seconds)
- These variables cannot be standardized, so:
 - Do we include illumination as it exists on average in patient photography OR
 - Do we eliminate illumination as a variable for the purposes of testing



Impact of flat field/angle of view

- Concern on chromatic aberration with field of view lens changes
 - How to determine standard angle of view (clinical vs. testing)
 - Do all the viewing angles need to be tested?
- Concern on flat target
 - Does it need to be curved?



Phase III...

- Modify color patches, model eye if needed
- Extended camera testing at multiple sites
- Software implementation strategies
- Final feasibility report
 - Manufacturer vs. user implementation

Thanks to:

Color Model Eye Group Members

- Bill Fischer *Flaum Eye Institute, University of Rochester Medical Center*
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- Tim Bennett *Penn State Hershey Eye Center*
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- Susan Farnand *Munsell Color Science Laboratory, Rochester Institute of Technology*
- Matt Carnavale *Sonomed/Escalon*
- Kevin Langton *Carl Zeiss Meditec*
- Rich Amador *Canon*
- Dennis Thayer
- And Katelyn Donovan *RIT Photographic Sciences '14*

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