The Lens Structure, Function and Pathology

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Handout available at:
http://www2.surgsci.uu.se/ophthalmology/Downloads/LensHouston/lens.pdf


Uppsala university
Uppsala
Sweden

Uppsala university

- Oldest Scandinavian university founded in 1477 on the order of the pope before Sweden was founded as a nation in 1523
- Originally around 50, today 43 000 undergraduate students, and 2 400 PhD students

Gustavianum built 1622-25
Oldest remaining original university building, Today a science museum

Famous scolars

- Olaus Rudbeck, medicine (17th cent.)
  Description of lymf system
- Anders Celcius, astronomy (18th cent.)
  Centigrade scale for temperature
- Carl von Linné, botany (18th. cent.)
  Nomenclature system for plants
- Jöns Jacob Berzelius, chemistry (18th. cent.)
  Discovery of oxygen
- Anders Jonas Ångström, physics (19th cent.)
  Angstrom unit (Å) för distance (10^{-10} m)
- Theodor Svedberg, chemistry (20 th. cent.)
  Nobel Laureate, invention of ultracentrifugation
- Niklas Zennström, computer sc. (20 th. cent.)
  Streaming of music, founder Skype

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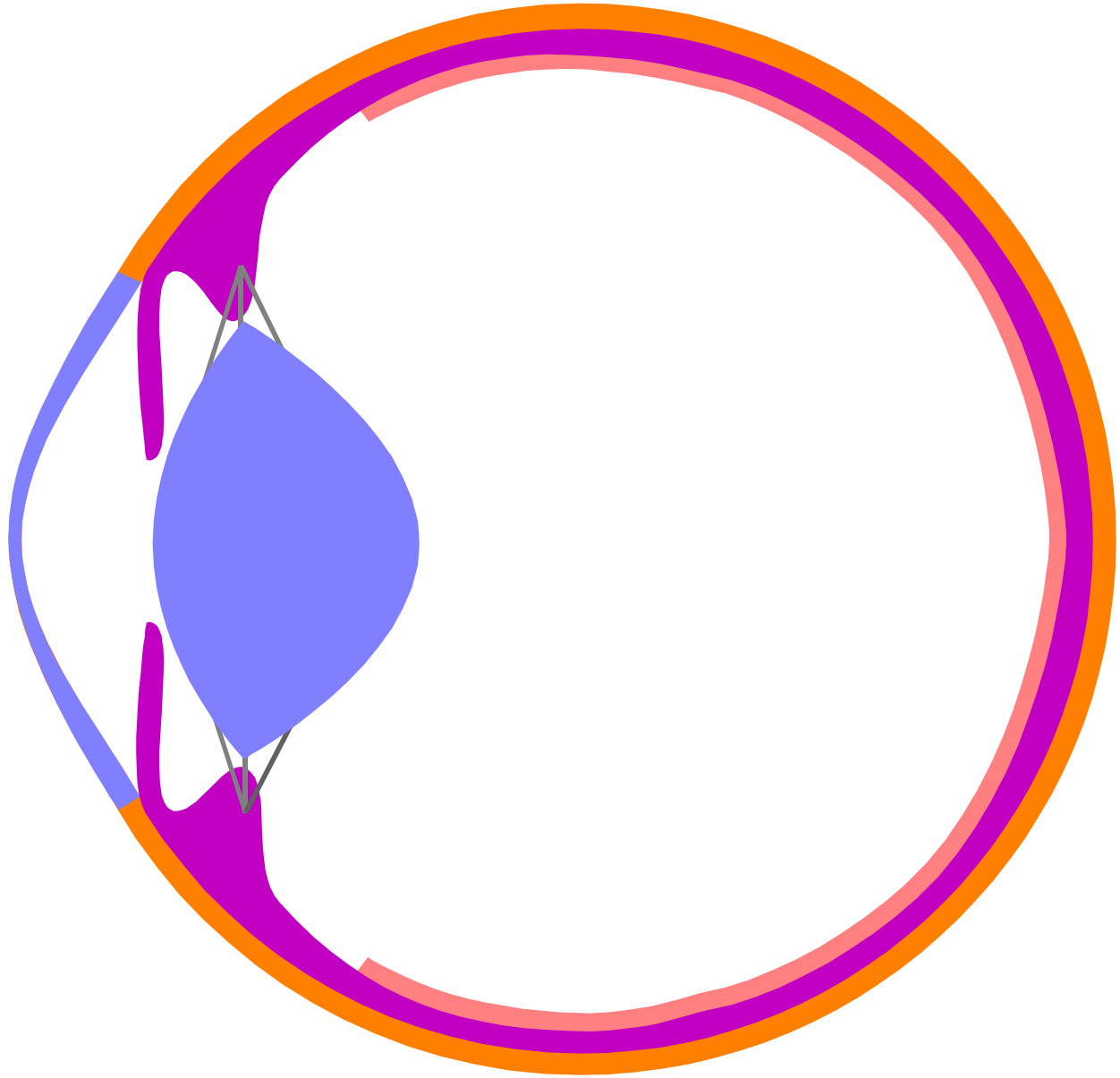
Allvar Gullstrand
Nobel laureate 1911
1st professor of ophthalmology
Uppsala University, Sweden

Professor Anders Bill
Modern view of IOP control
and ocular circulation

Pharmacia
- Commericialization Healon
- Commercialization Xalatan



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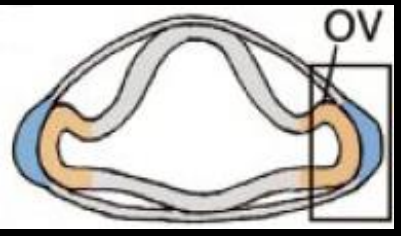
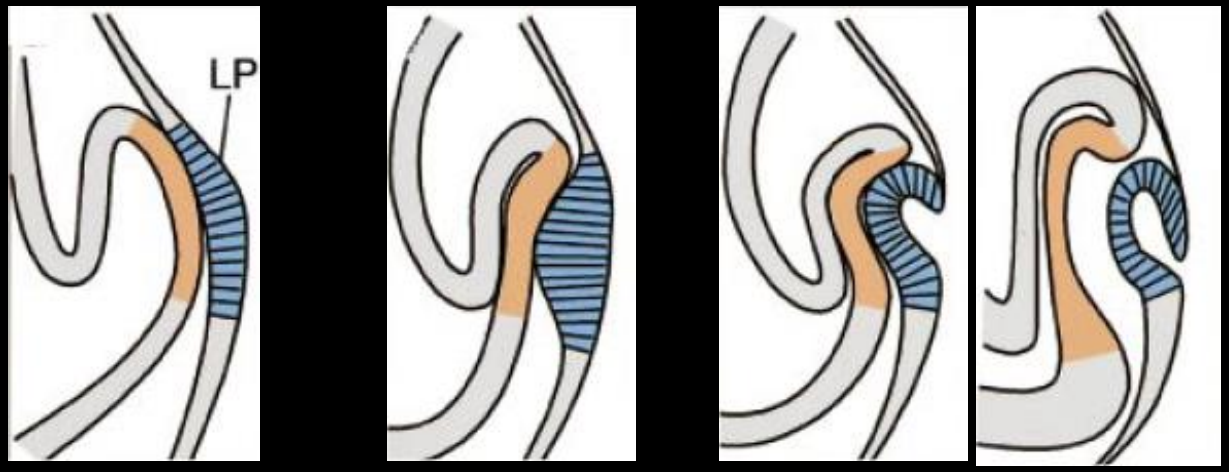


Embryology of the lens

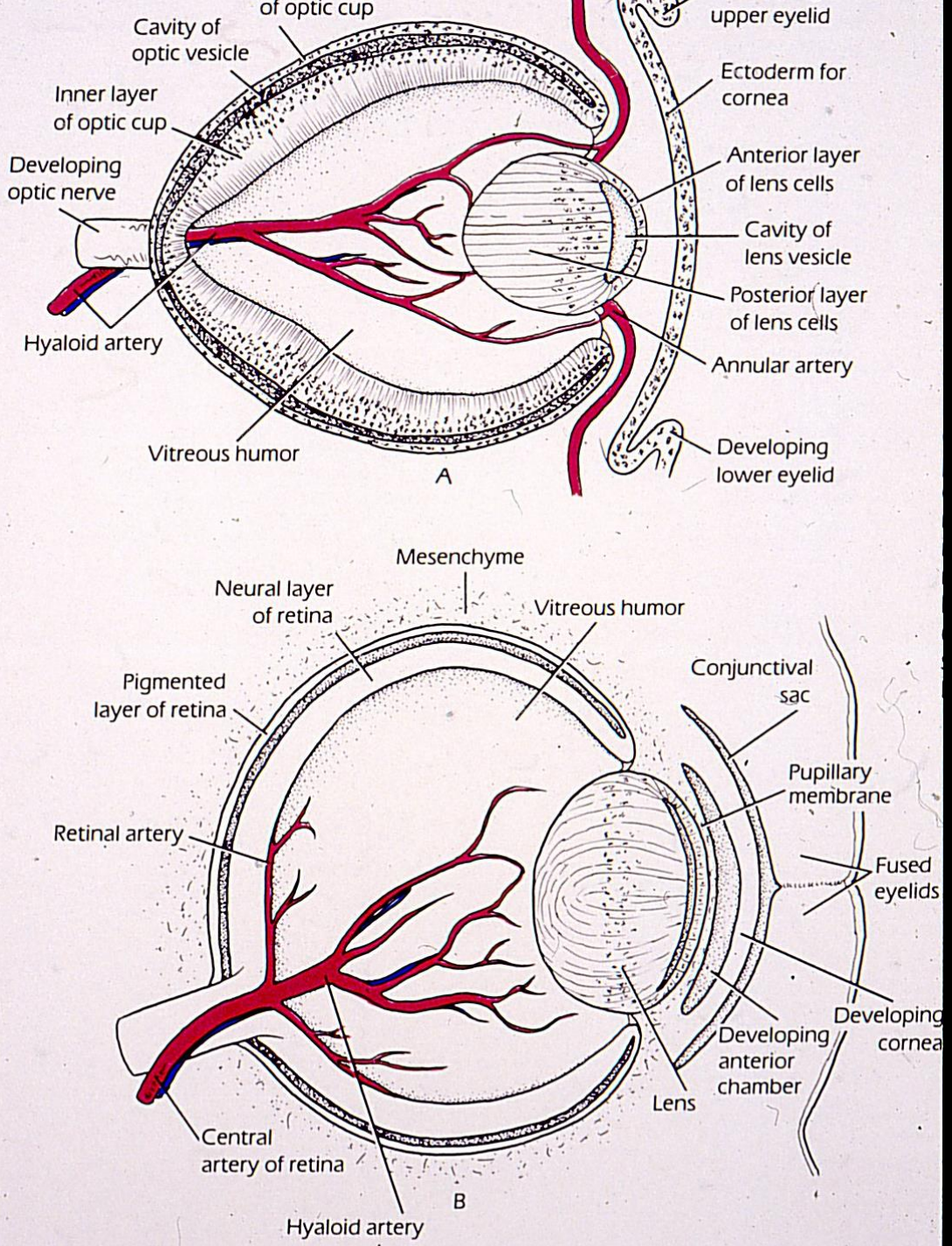
Gunnhaga, 2011



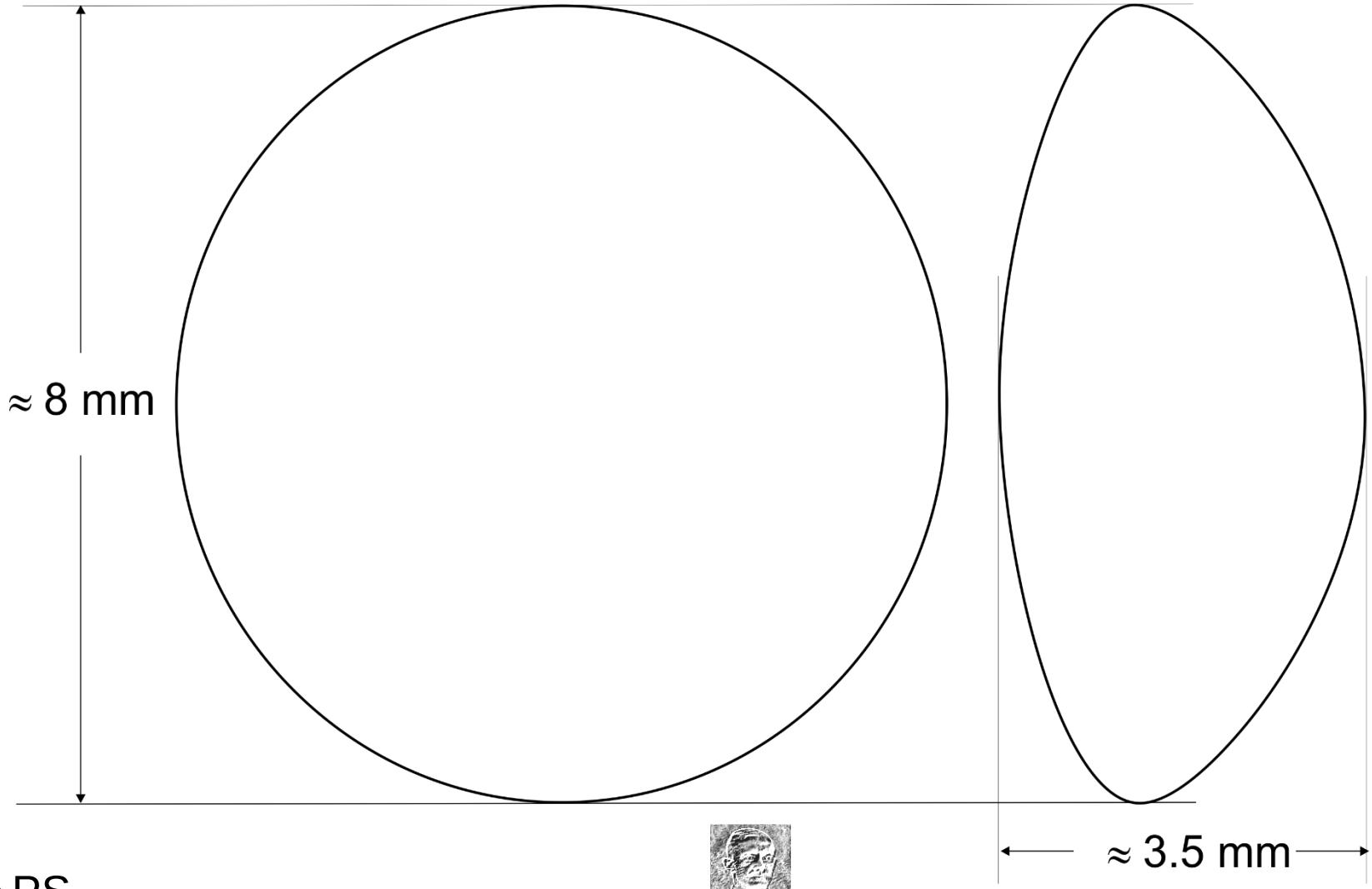
4 w

12 w

Ogino et al., 2000


of optic cup
Cavity of optic vesicle
Inner layer of optic cup
Developing optic nerve
Hyaloid artery
Vitreous humor
upper eyelid
Ectoderm for cornea
Anterior layer of lens cells
Cavity of lens vesicle
Posterior layer of lens cells
Annular artery
Developing lower eyelid
A
Mesenchyme
Neural layer of retina
Vitreous humor
Pigmented layer of retina
Conjunctival sac
Pupillary membrane
Retinal artery
Fused eyelids
Developing cornea
Developing anterior chamber
Lens
Central artery of retina
B
Hyaloid artery

Macroscopic anatomy – lens dimension



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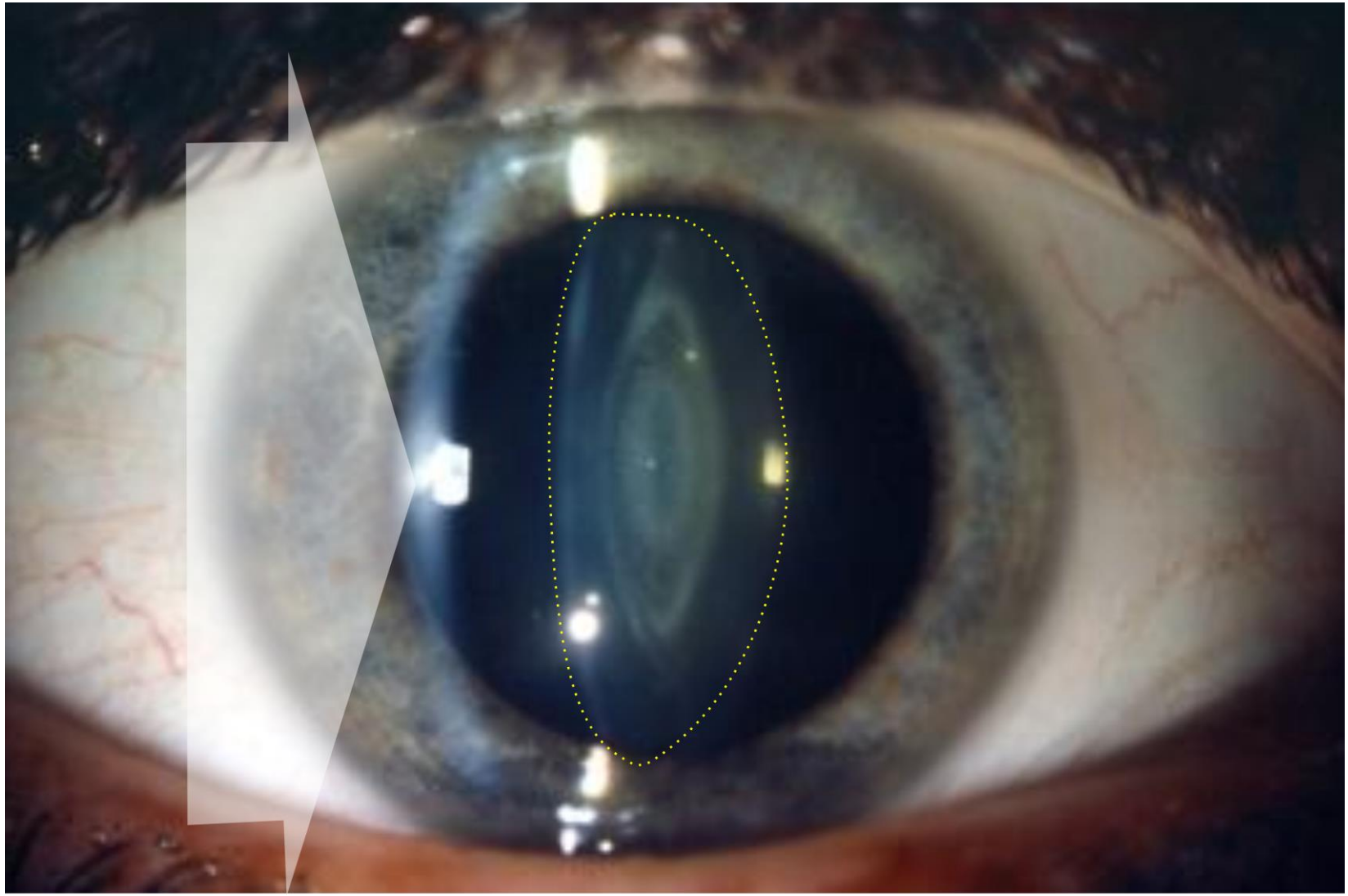
Macrosocopic anatomy – slitamp appearance



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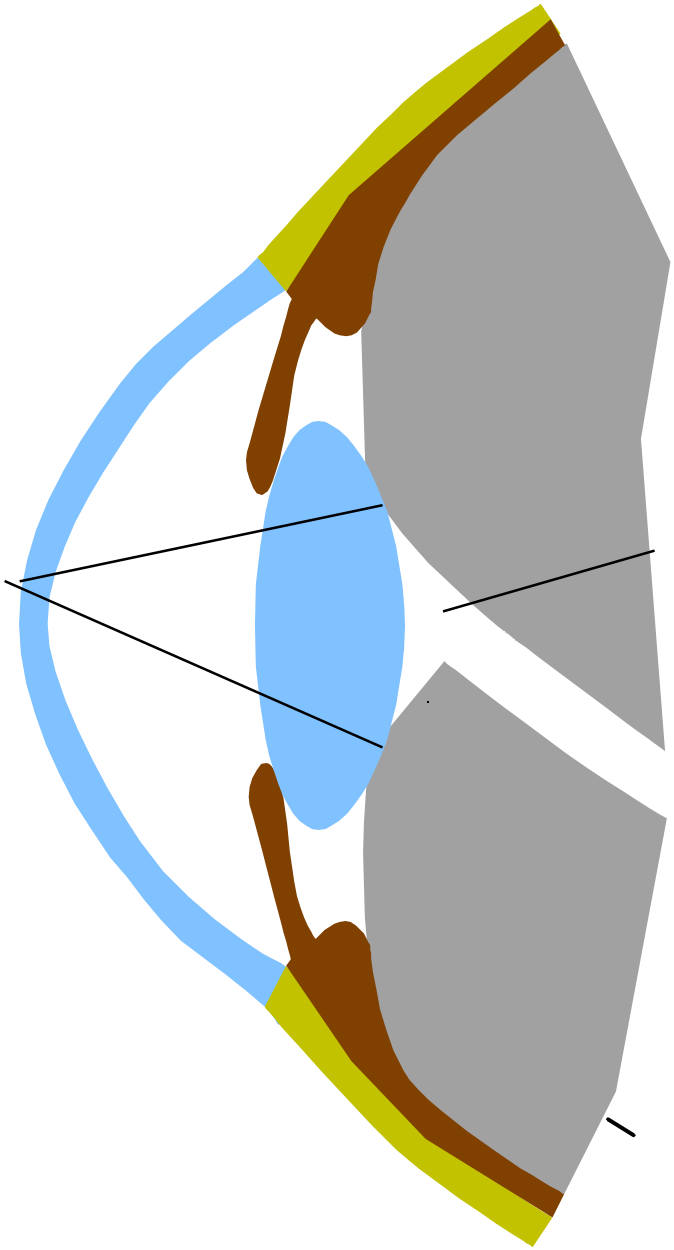
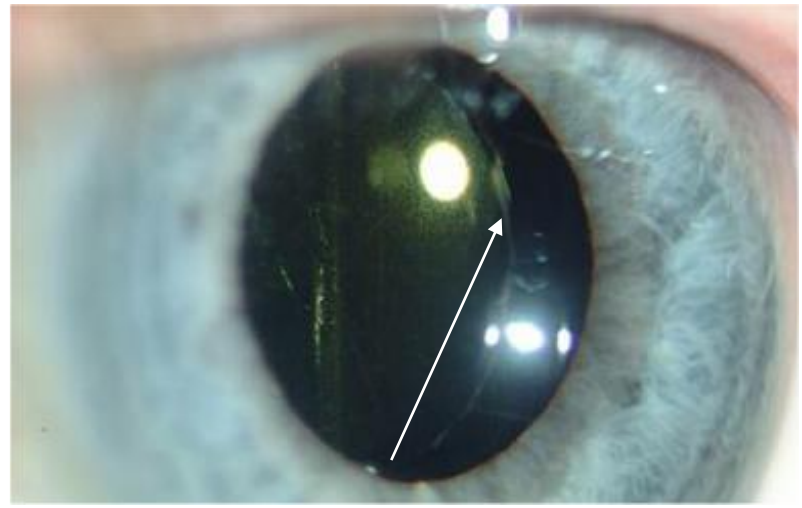


Wieger's ligament



Berger's spatium

Cloquet's canal

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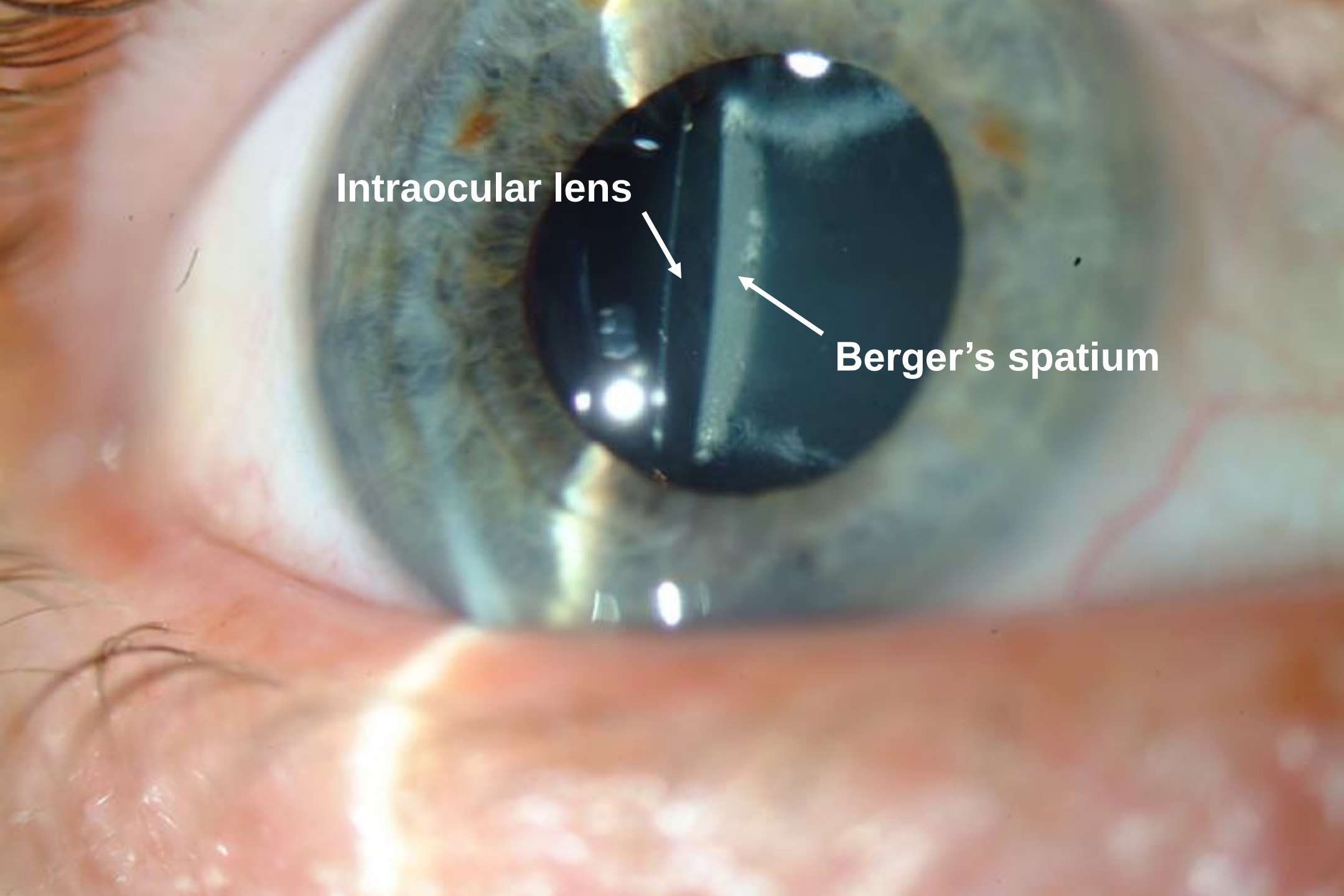
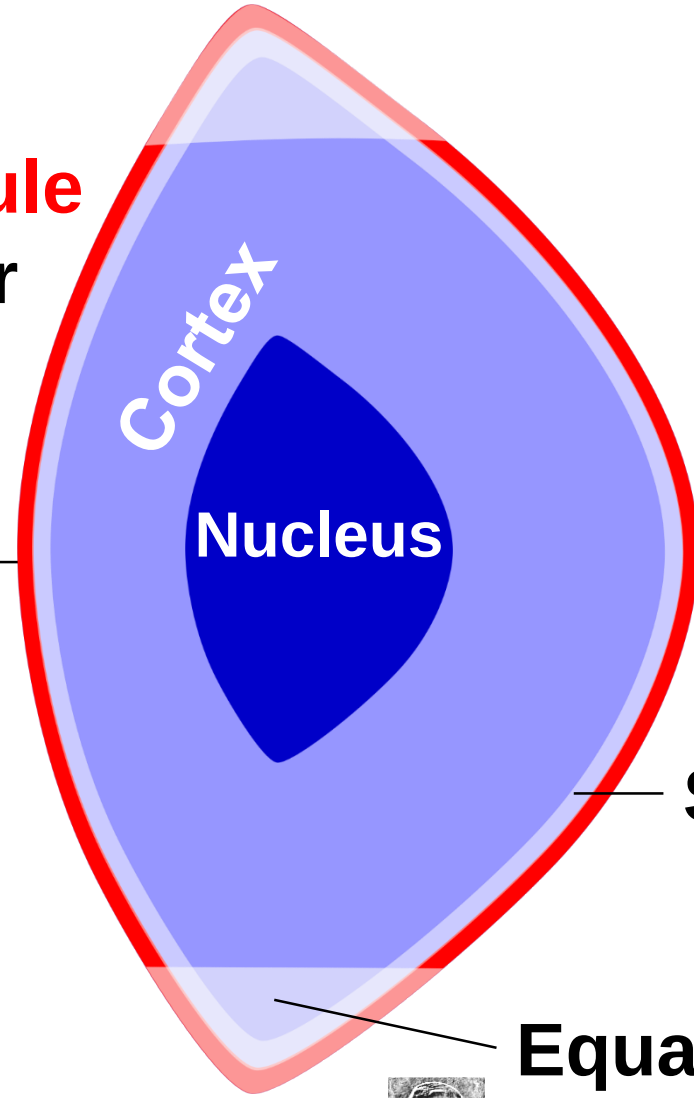

Intraocular lens
Berger’s spatium

Anatomical landmarks



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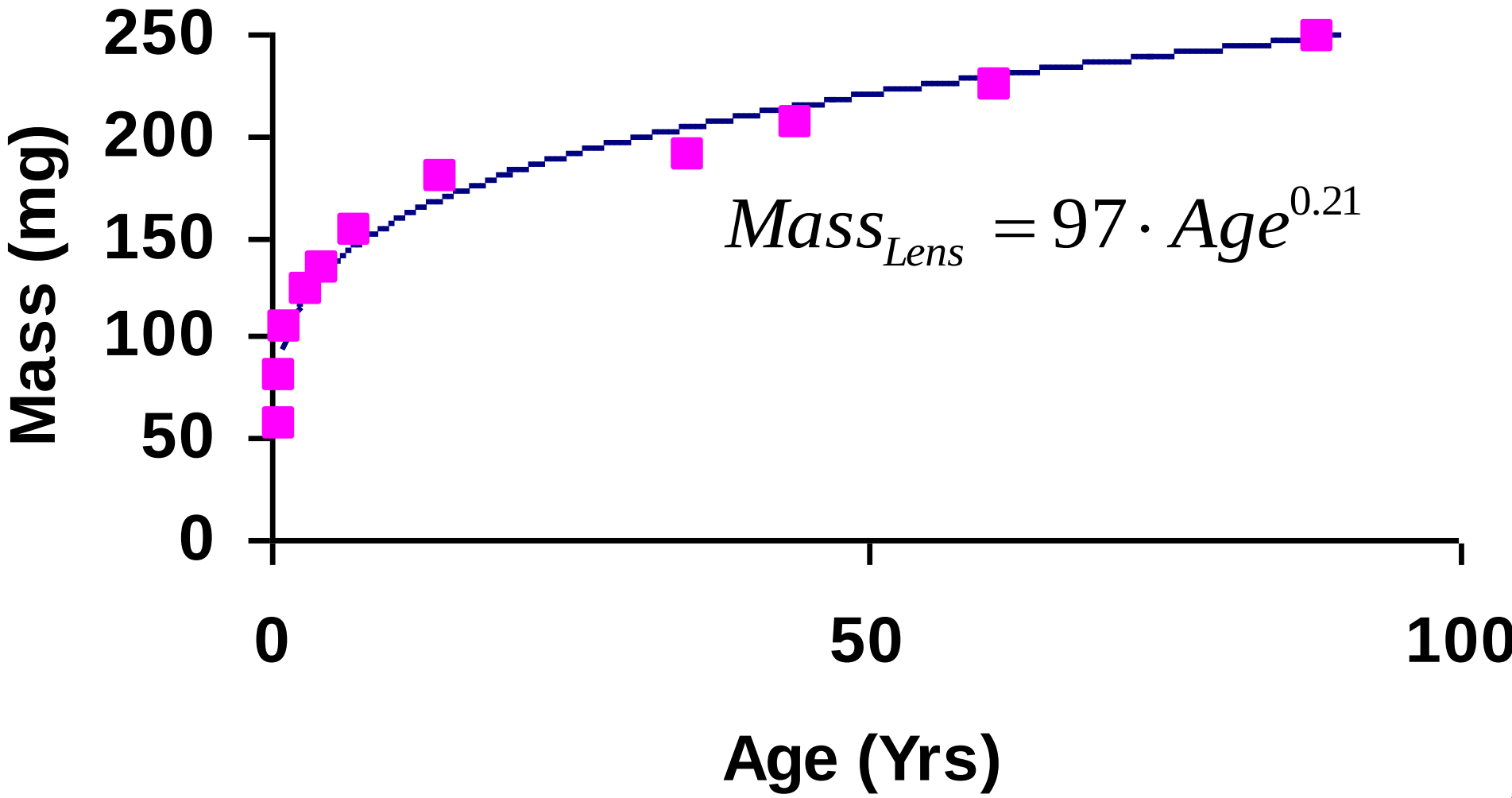
Human lens growth



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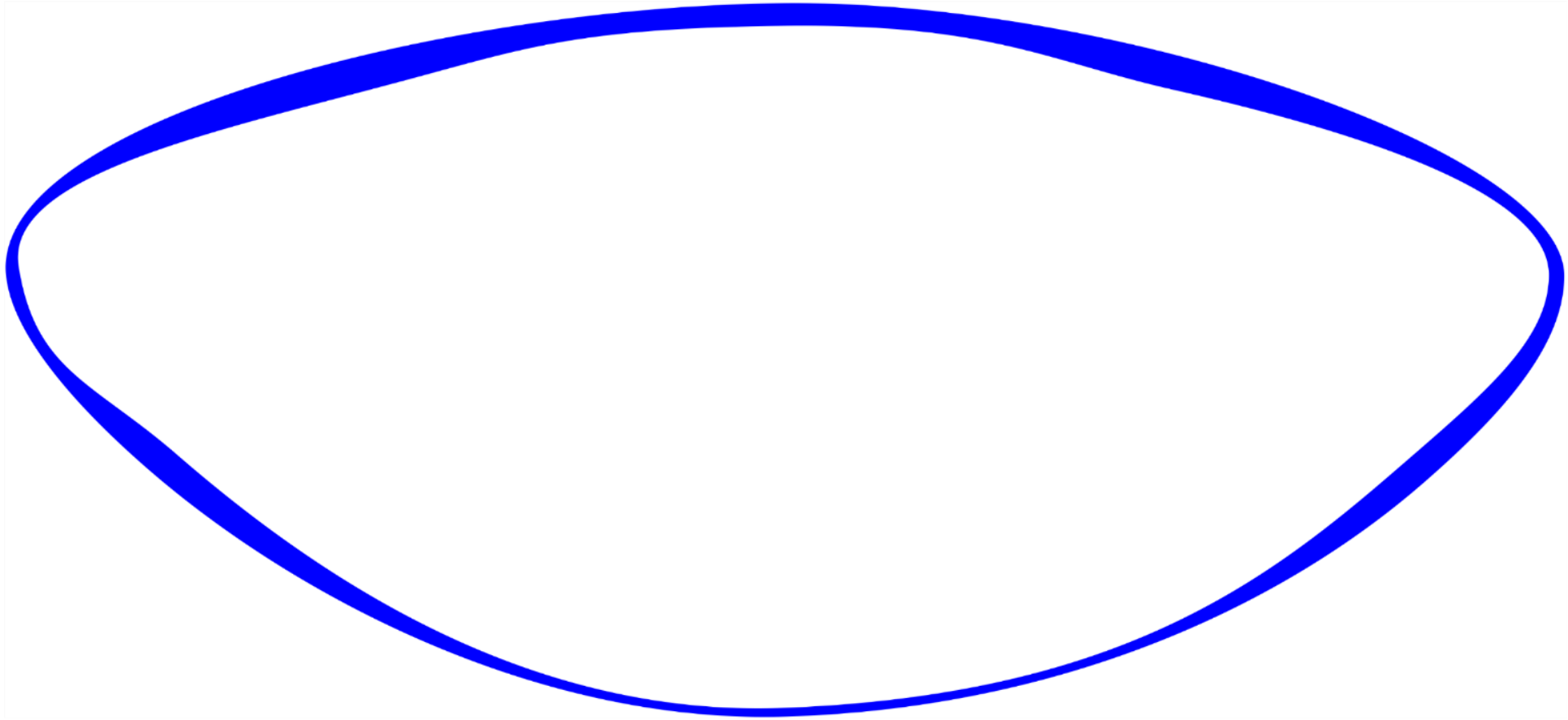
Microscopic anatomy – Lens capsule

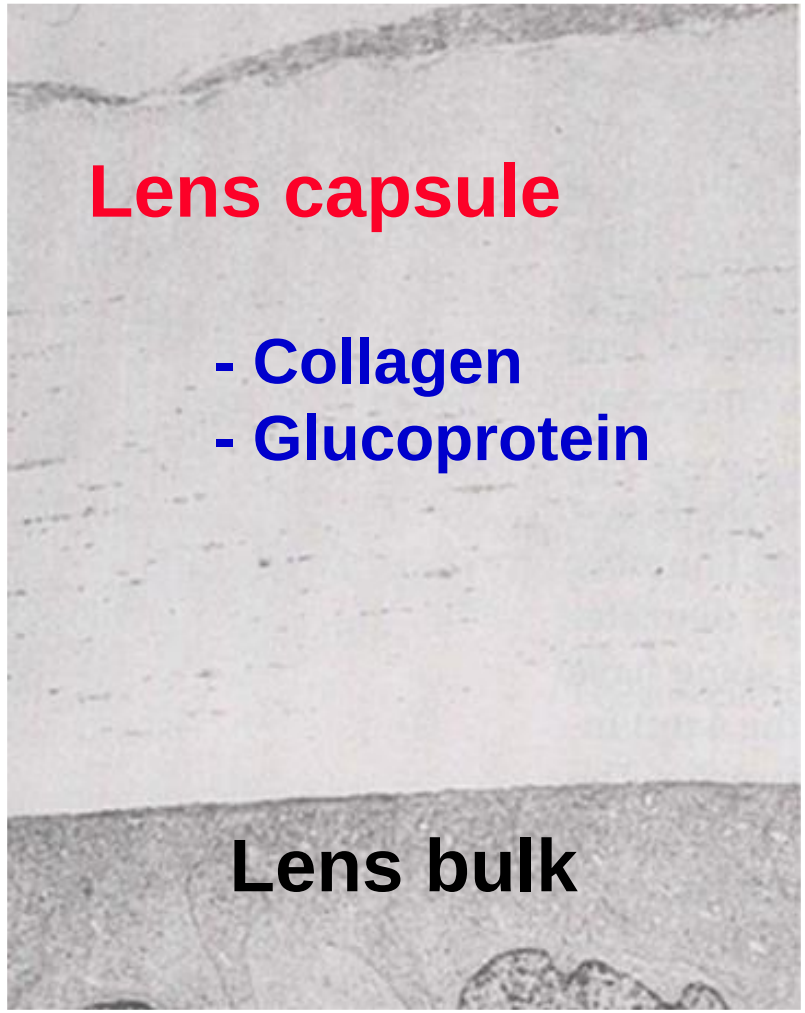
Anterior



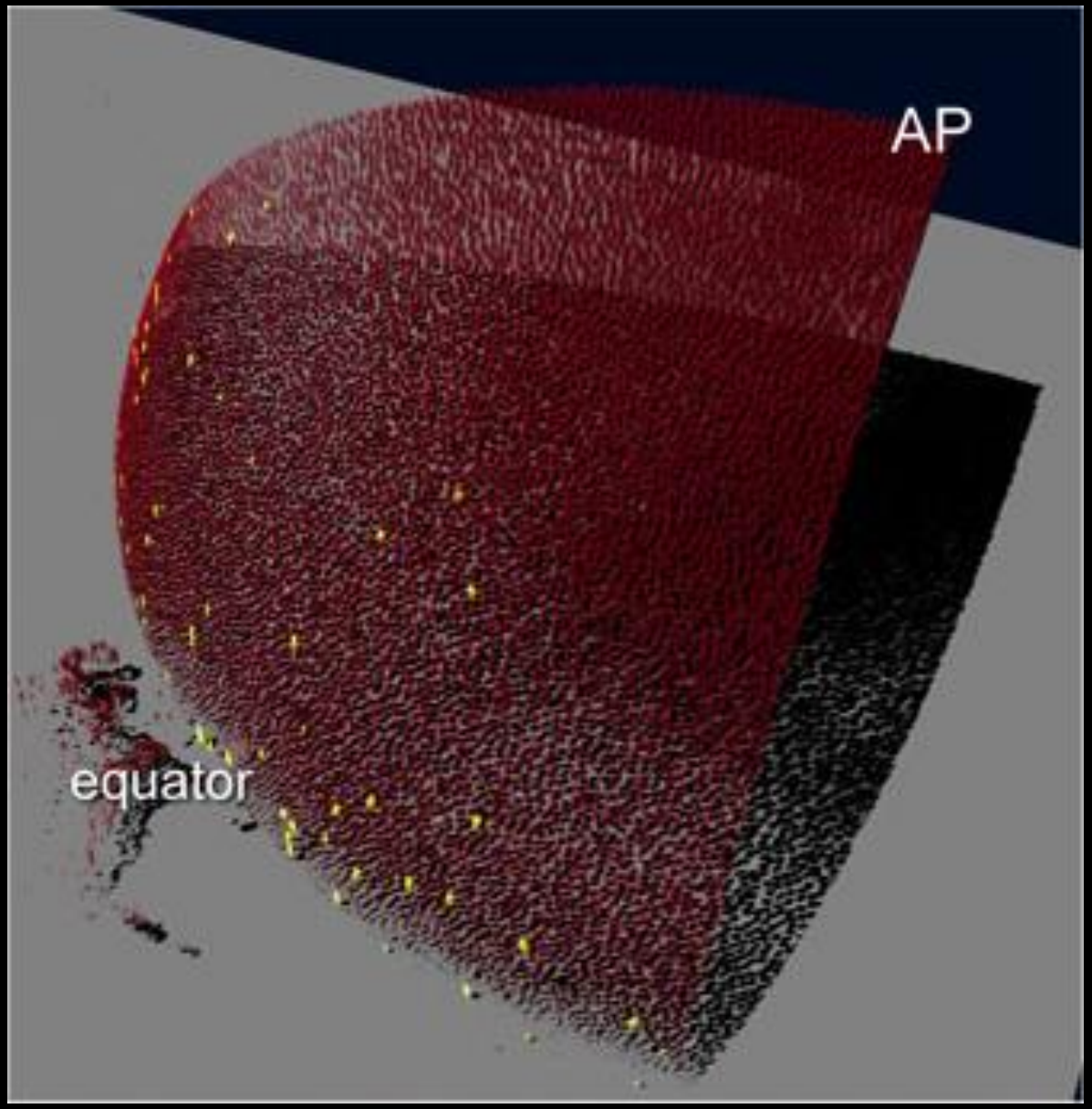
Posterior

Microscopic anatomy – Lens capsule

Anterior chamber

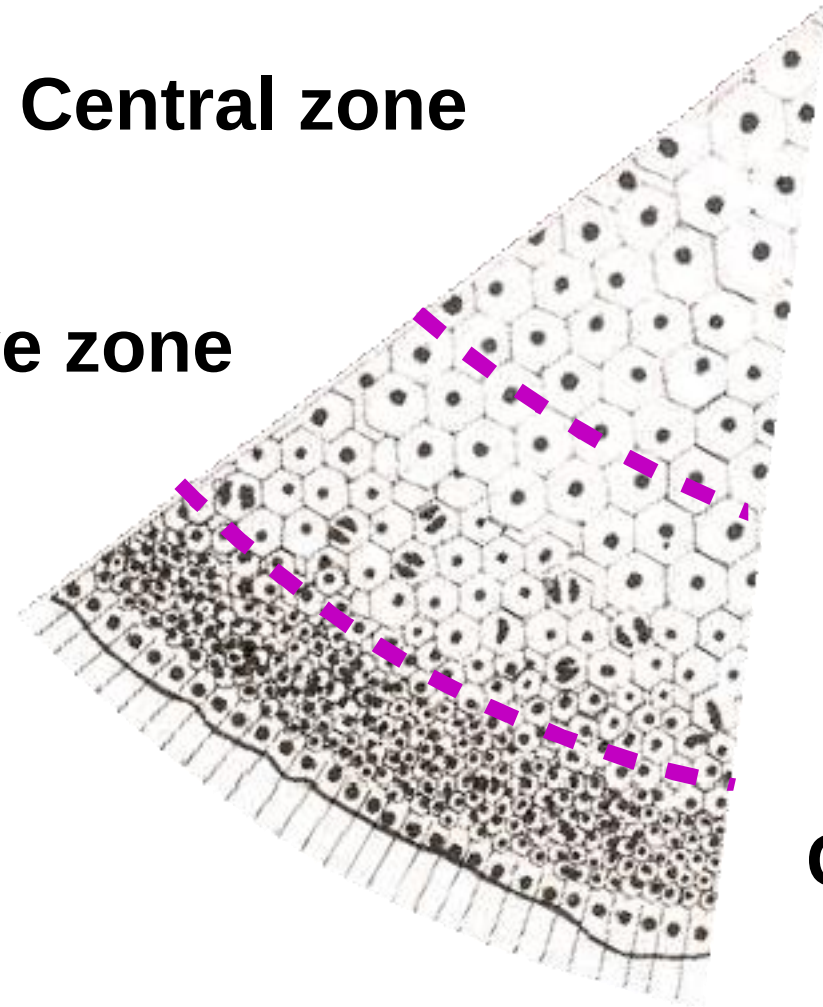


Microscopic anatomy – lens epithelium

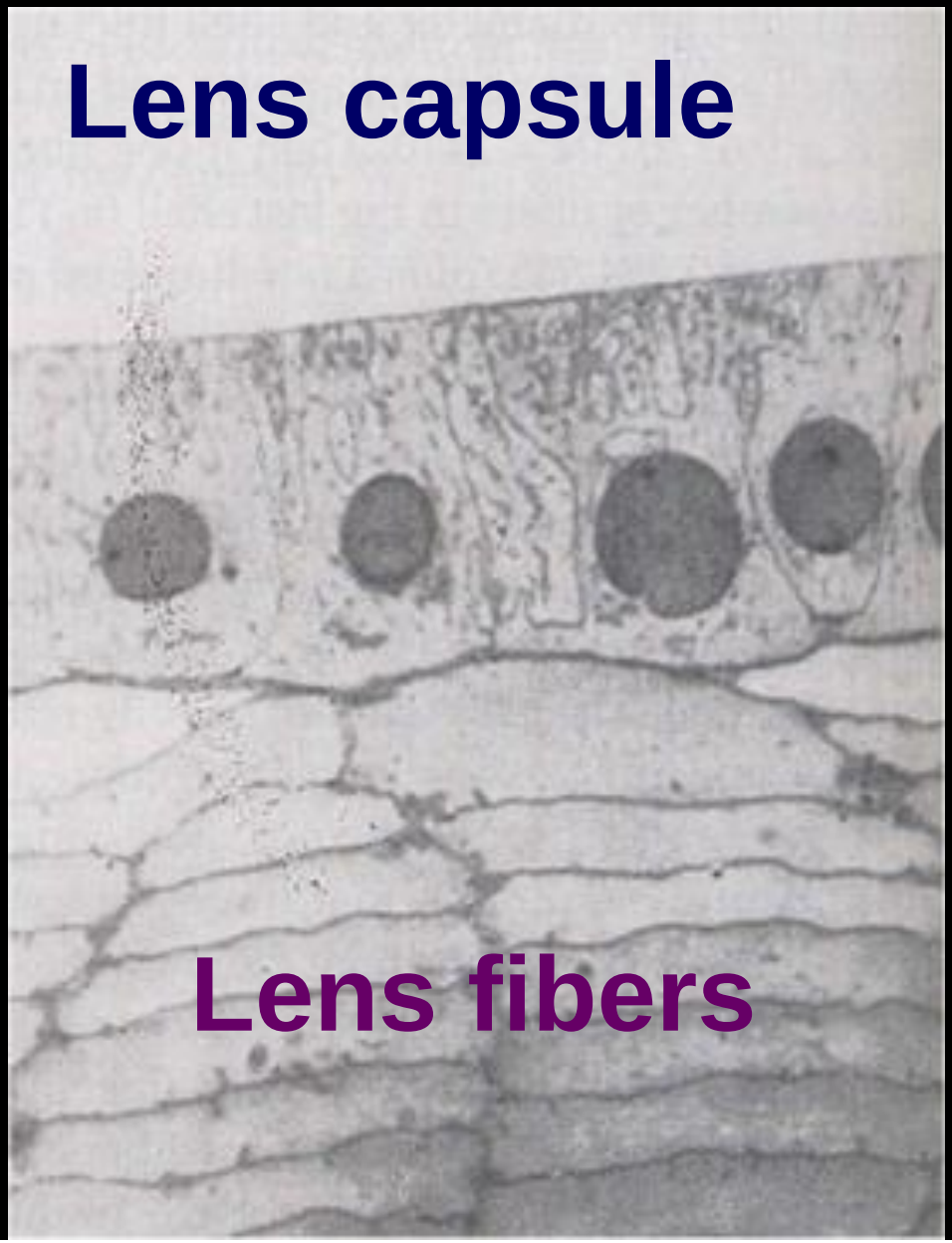


Bassnett et al. 2010

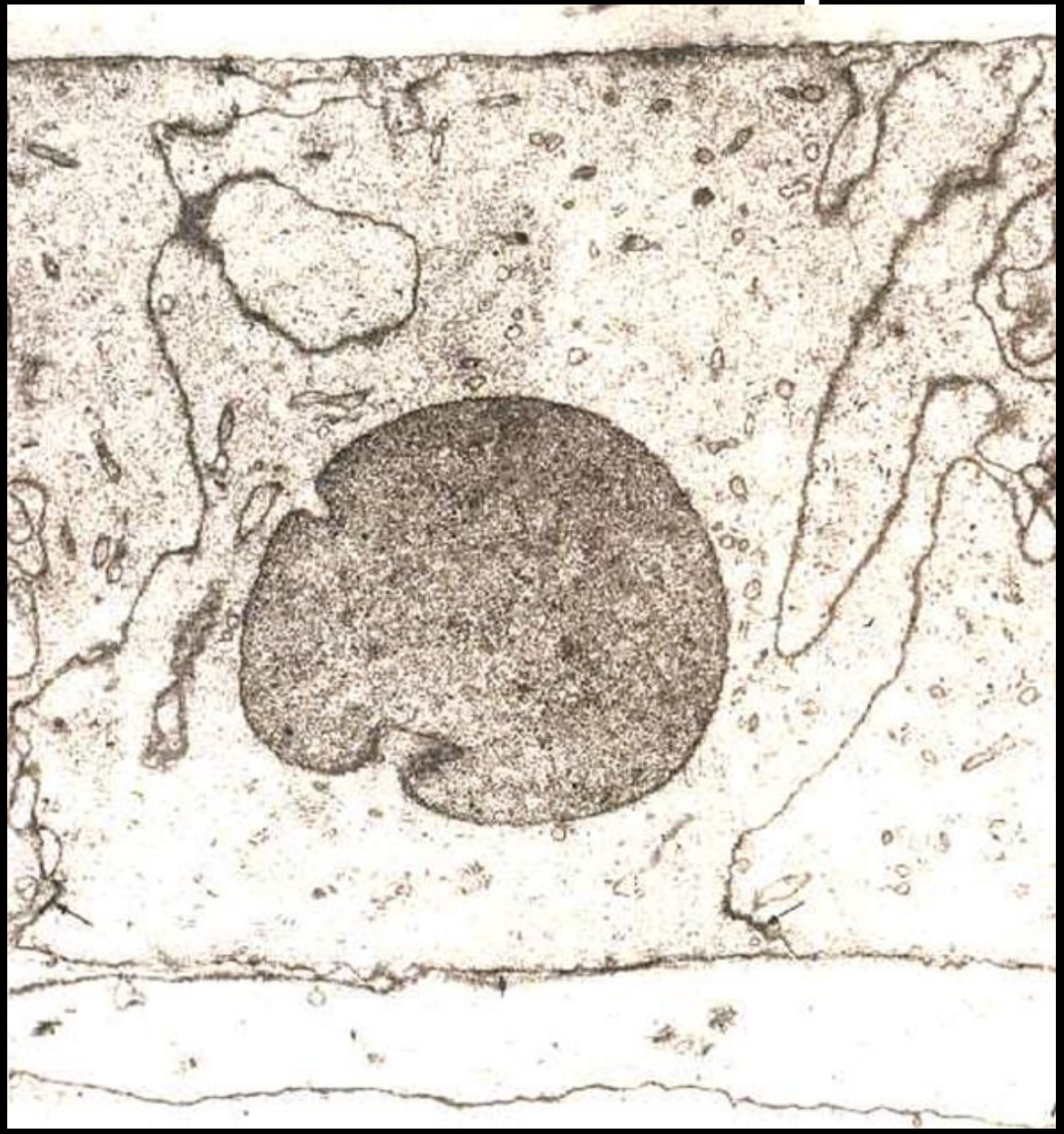
Microscopic anatomy – Lens epithelium



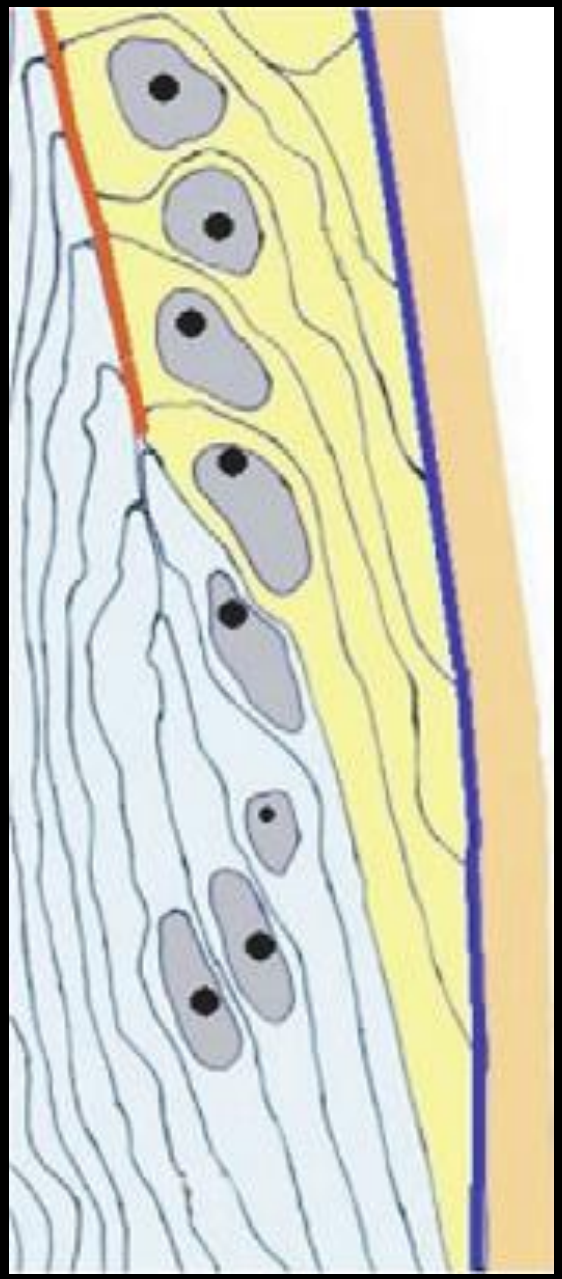
Ultrastructure – Lens epithelium



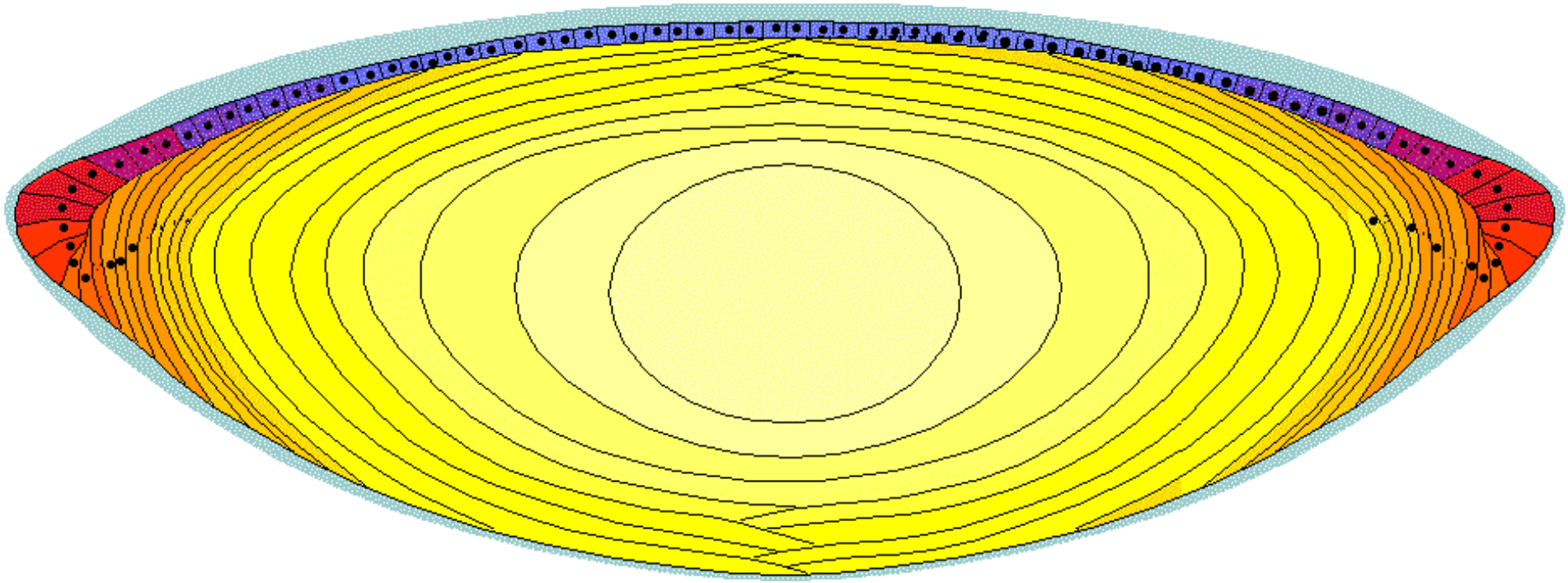
Ultrastructure – Lens epithelial cell



Microscopic anatomy – lens equator



Lens fiber cells



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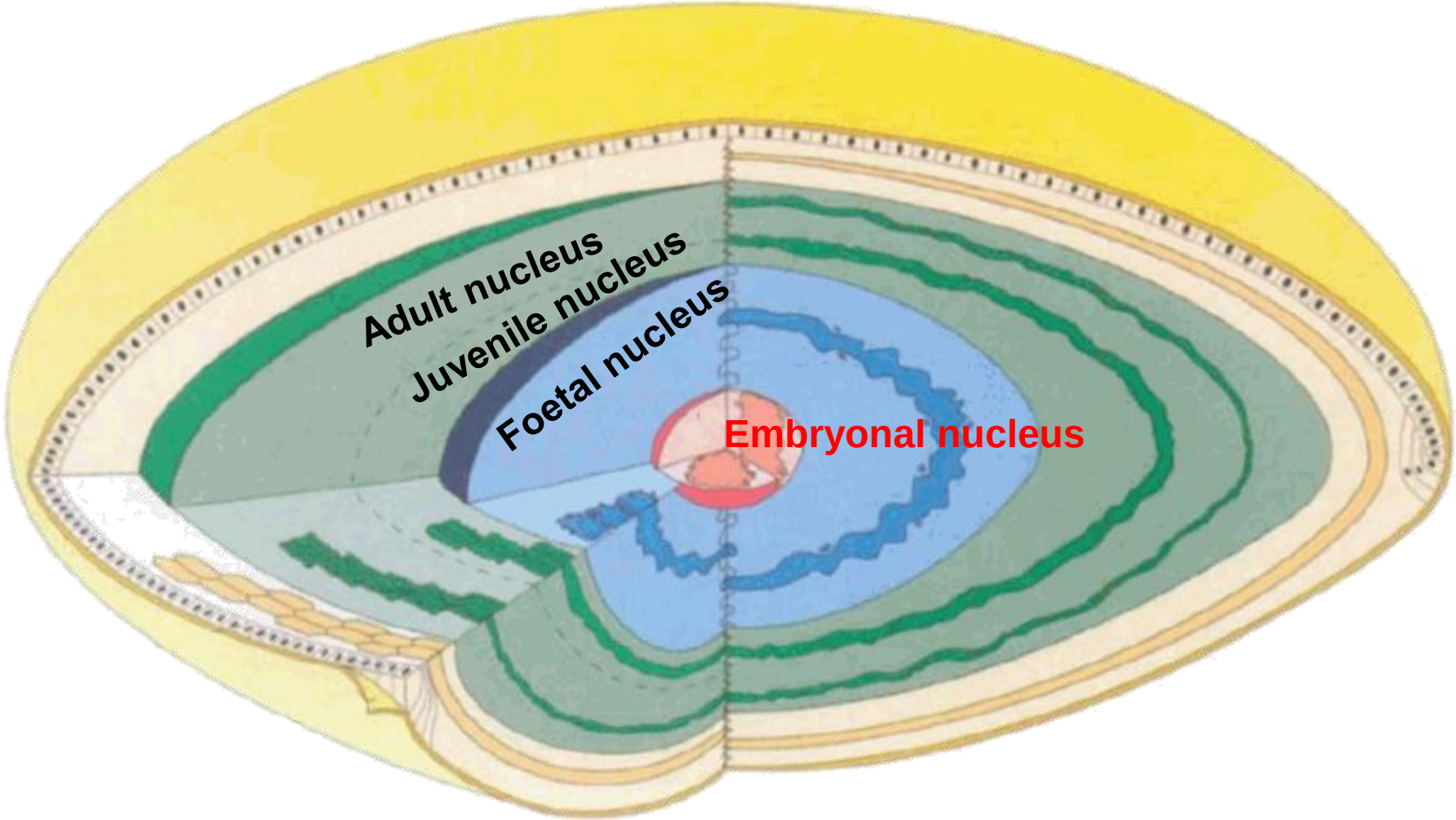
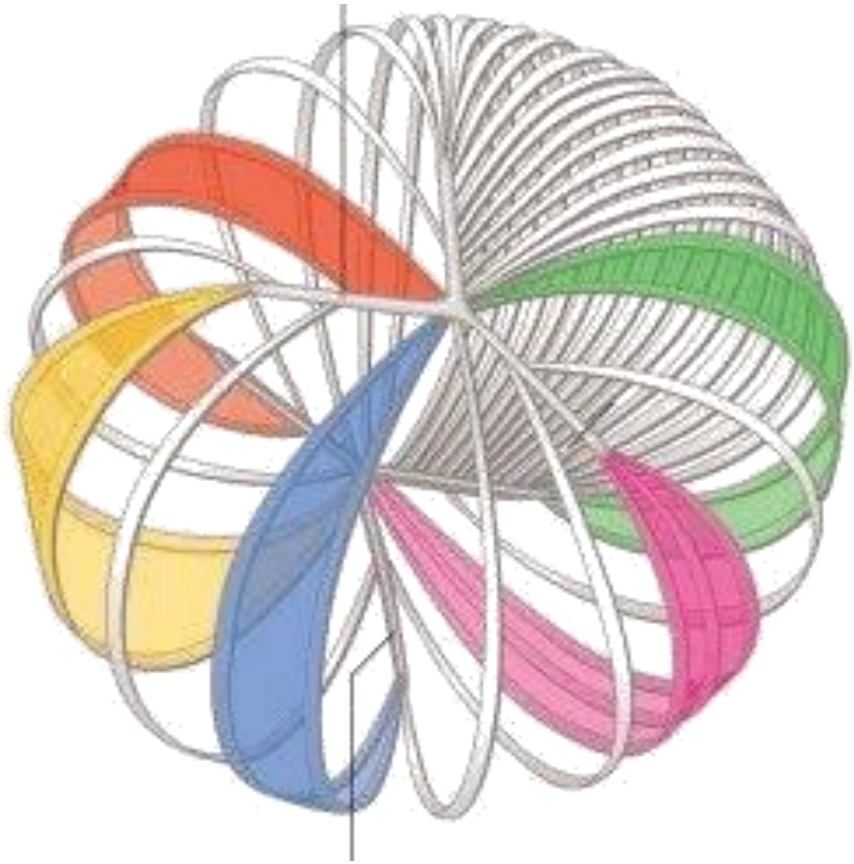
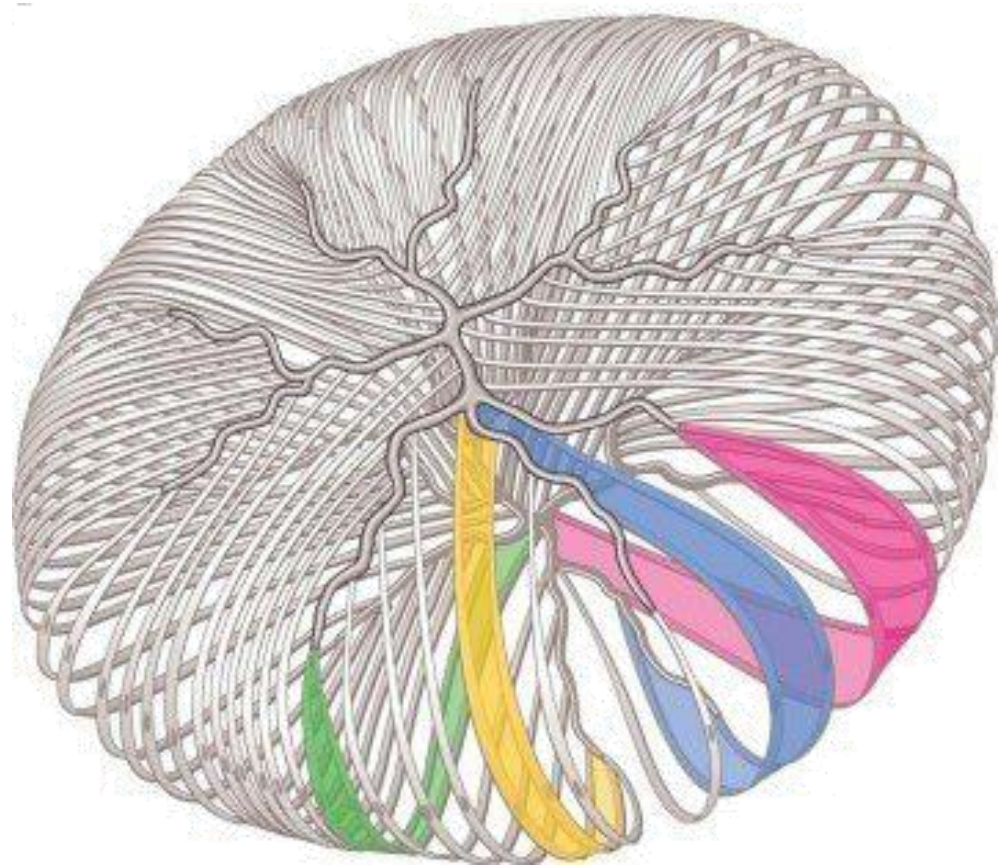
Lens nuclear zones



Lens fiber structure





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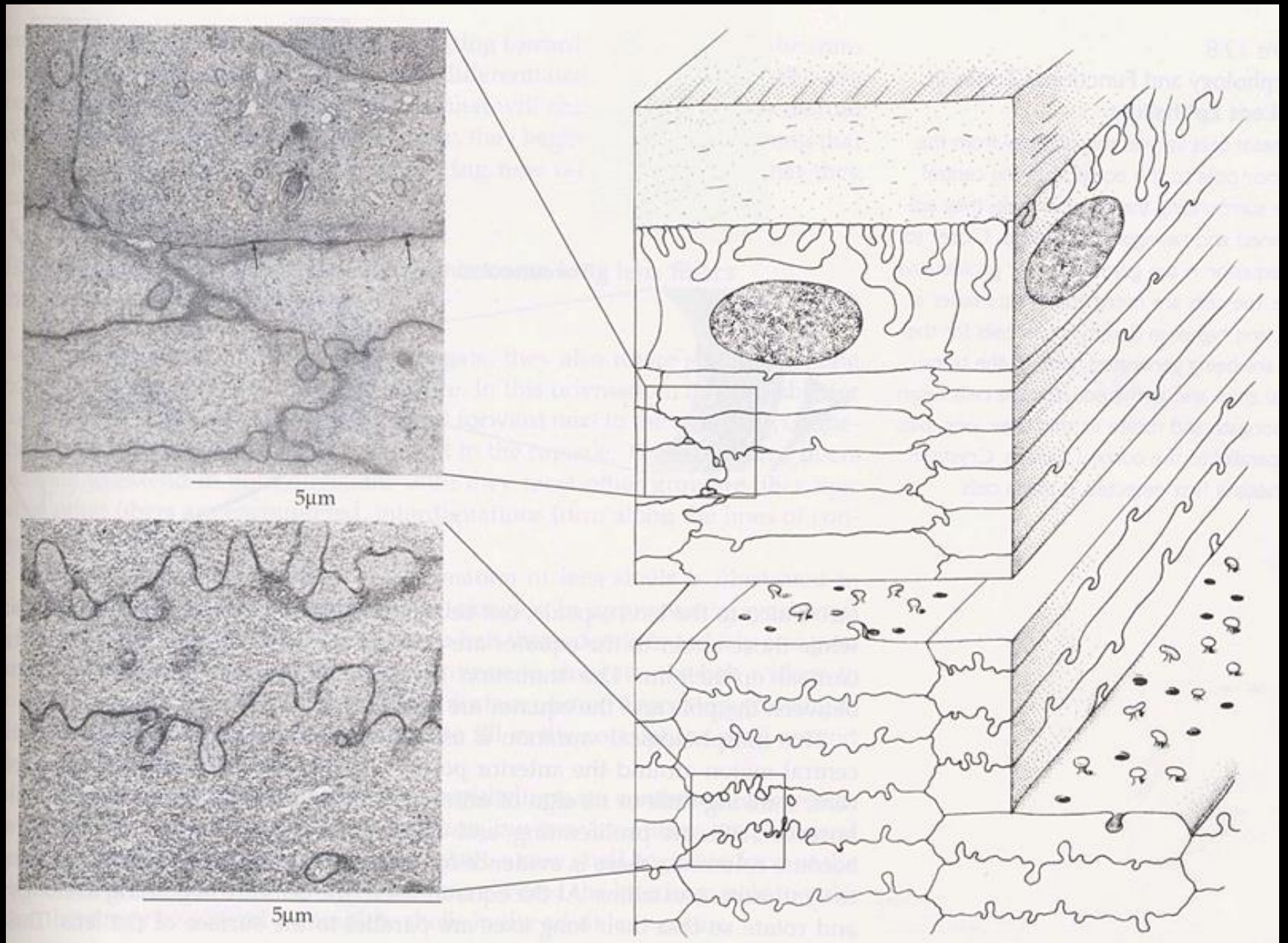
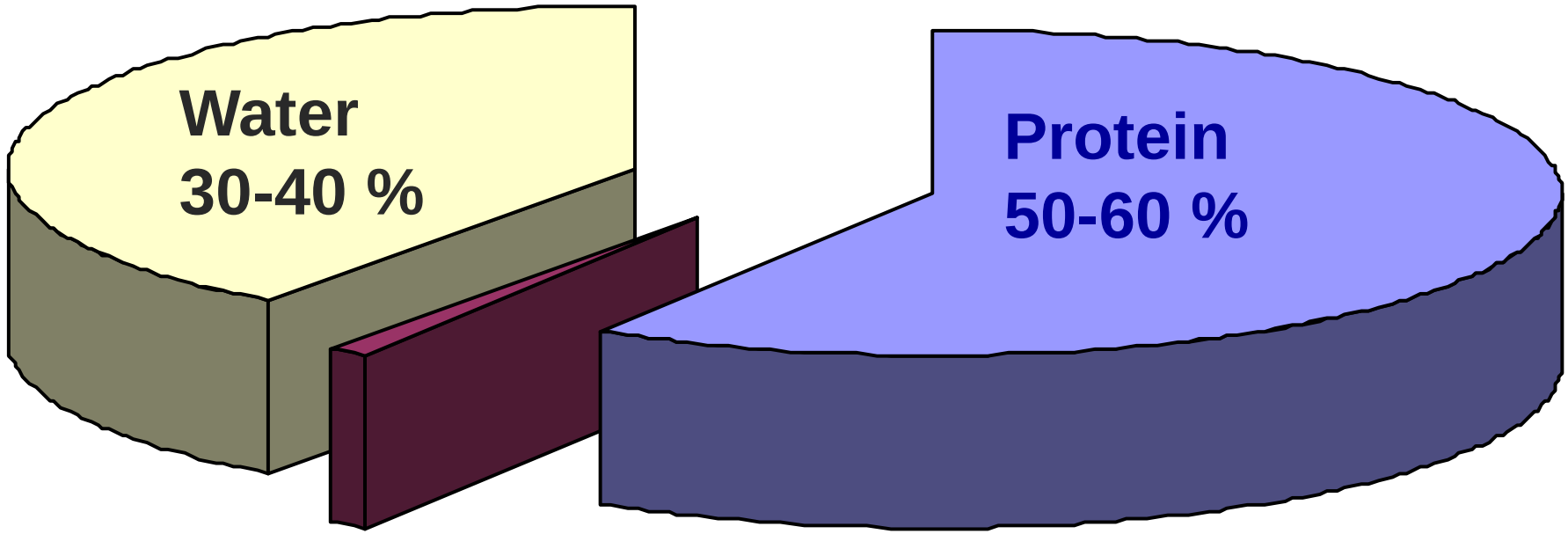
Ultrastructure – lens fibers



Chemical composition



Lipid membranes
Nucleic acids
Electrolytes

Water soluble – refractive index
Electrophoretic separation
α – crystallin
β – crystallin
γ – crystallin

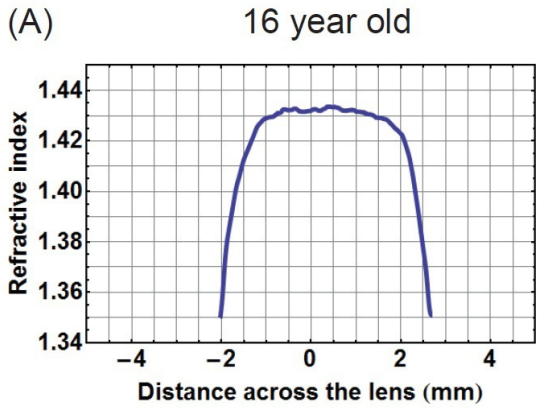
Water insoluble - Structure

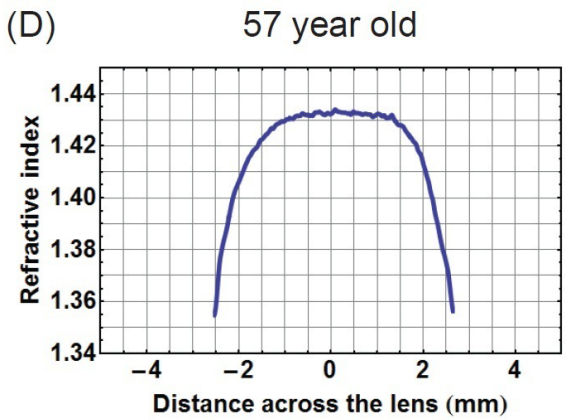
Physiological aspects

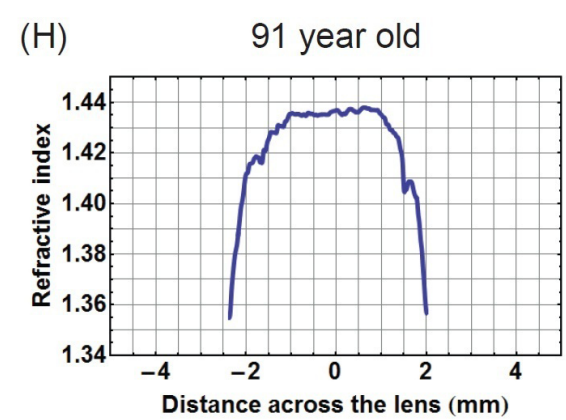
- **Refraction: n= k [Protein]**
  Osmotic problems

Refractive index gradient human

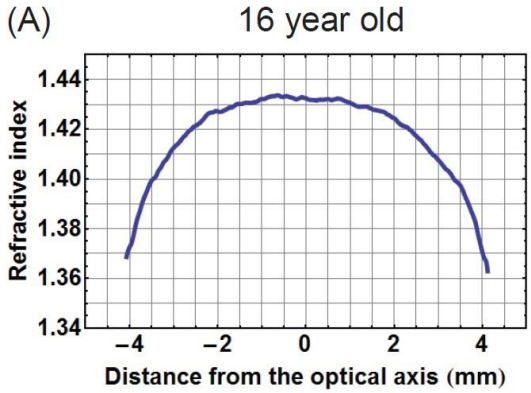
Anterior - posterior

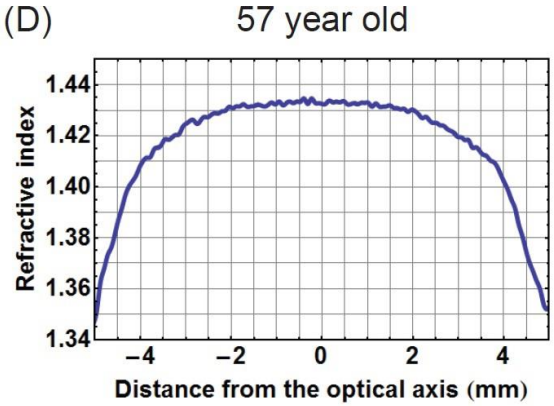


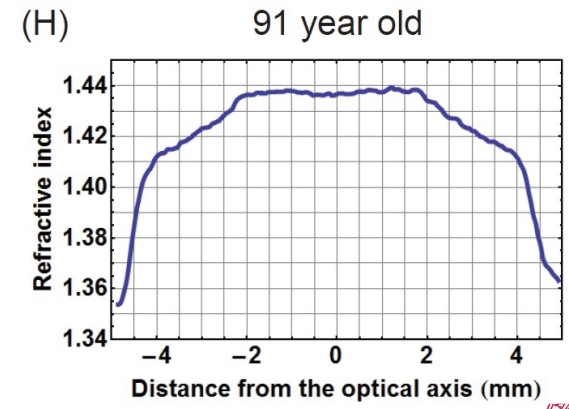




Side-Side







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Pierscionek et al. 2015

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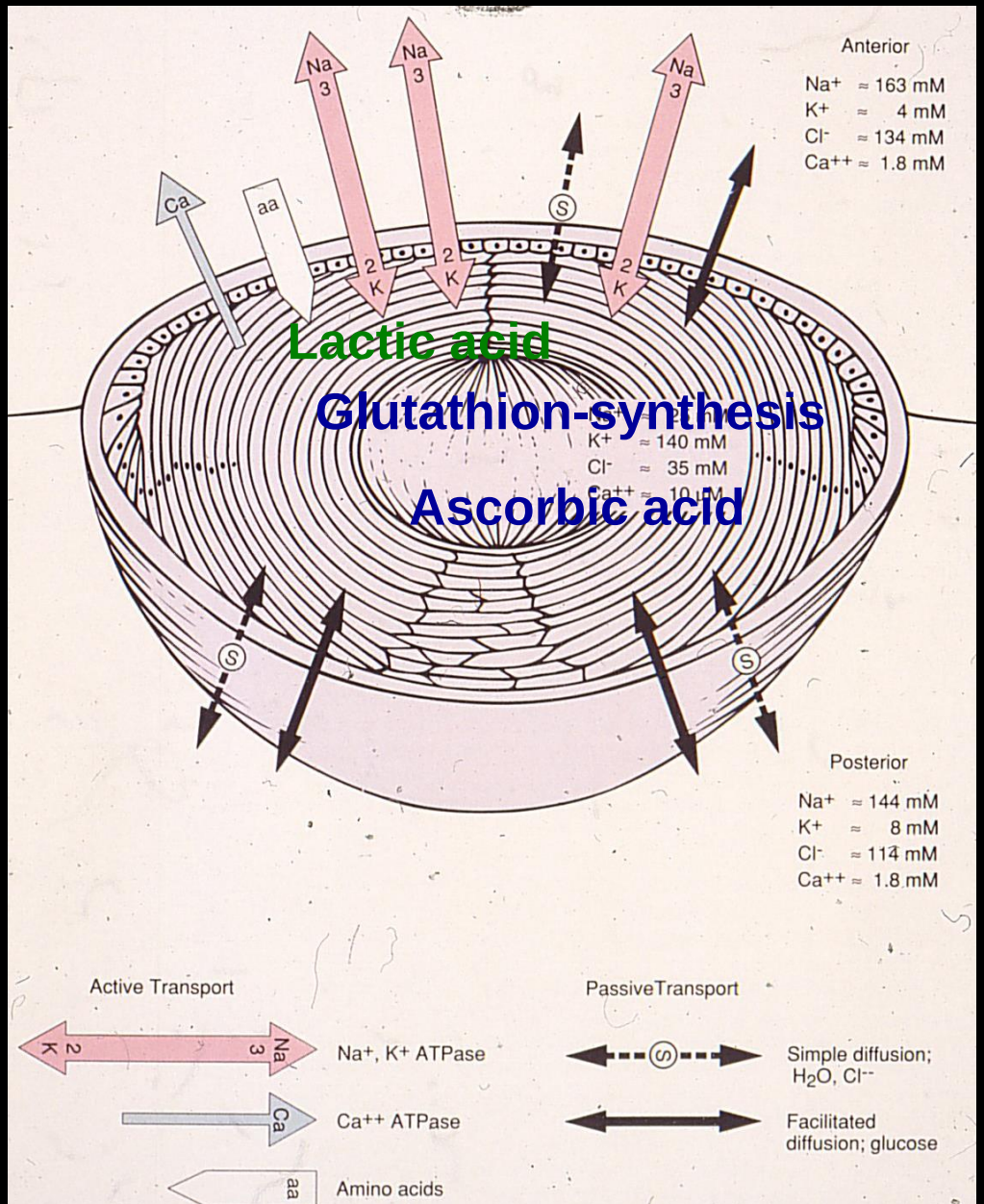
Physiological aspects – Transport



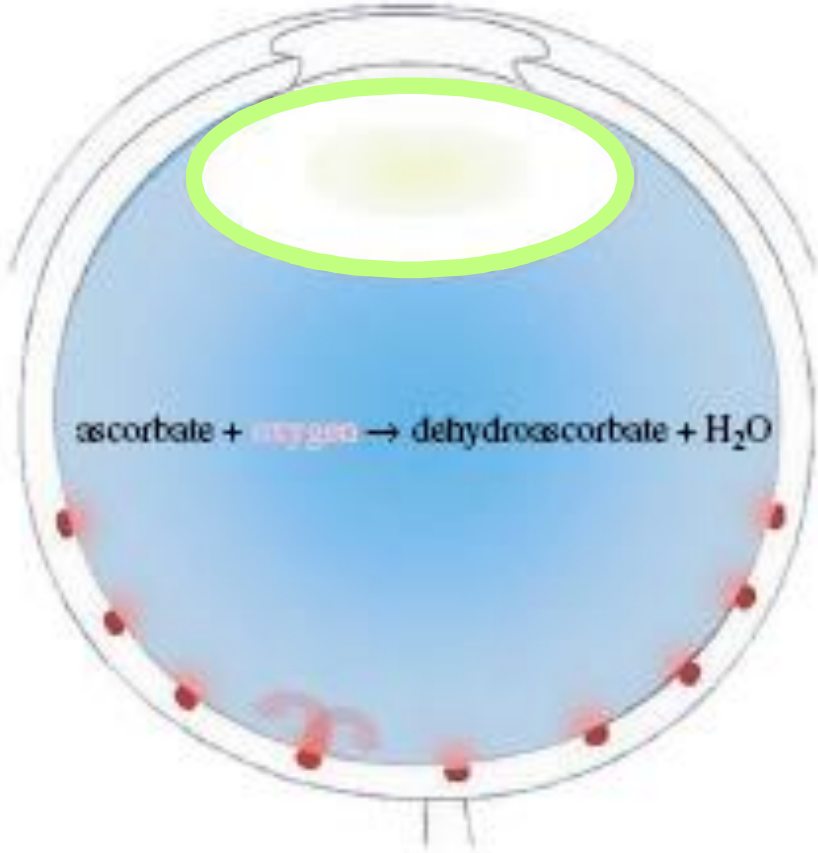
Predominantly anaerbic metabolism

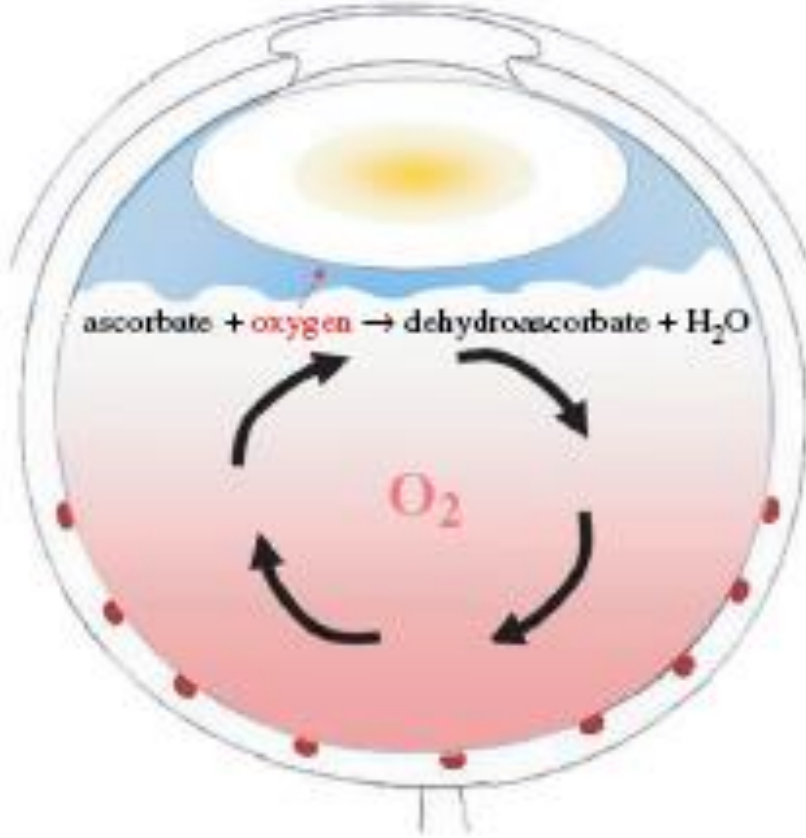
Highly oxygen senstivive

Lens oxygen

Normal **After vitrectomy**

Aerobic metabolism





O_2

High

Low

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Beebe et al., 2011

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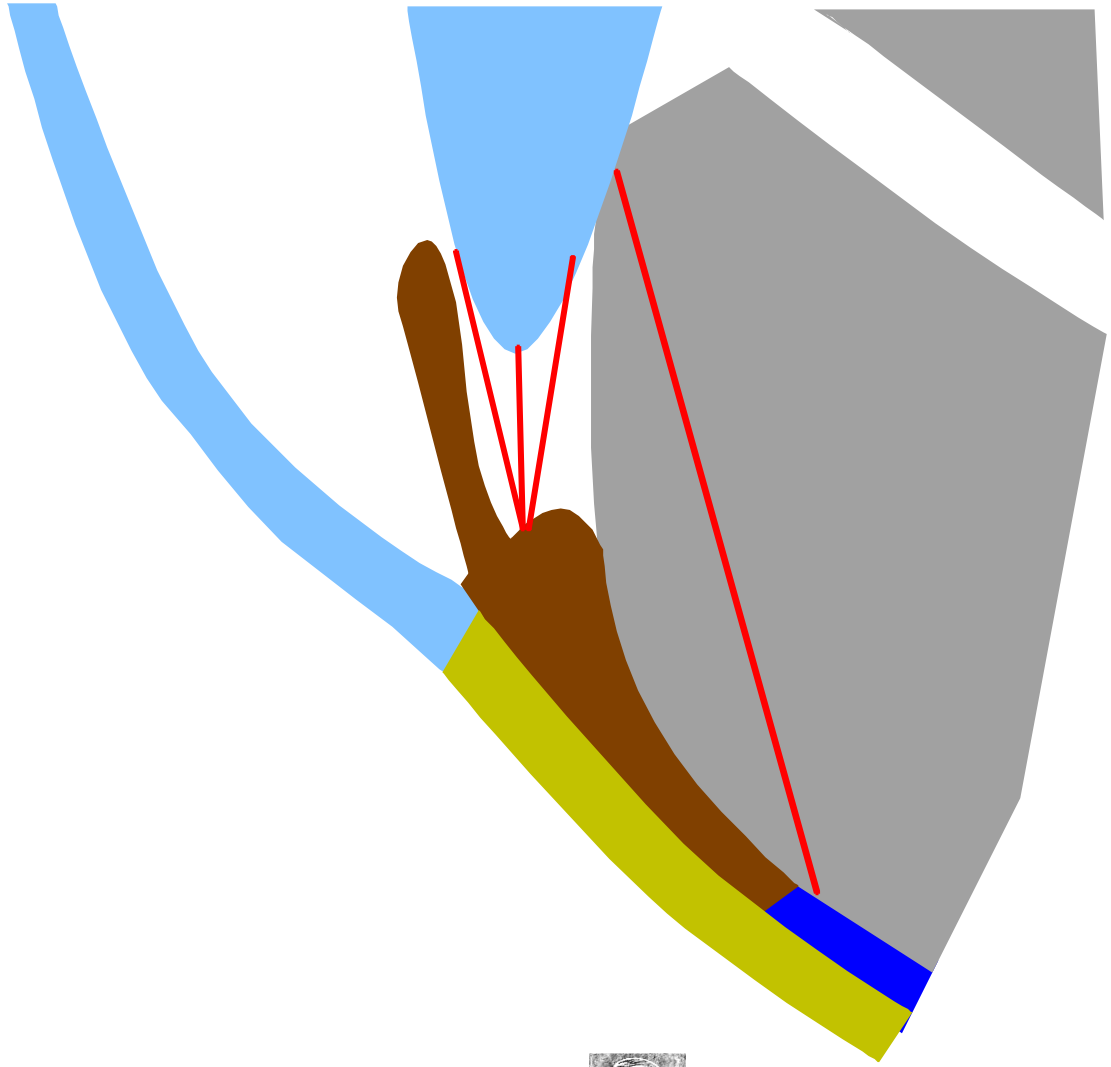
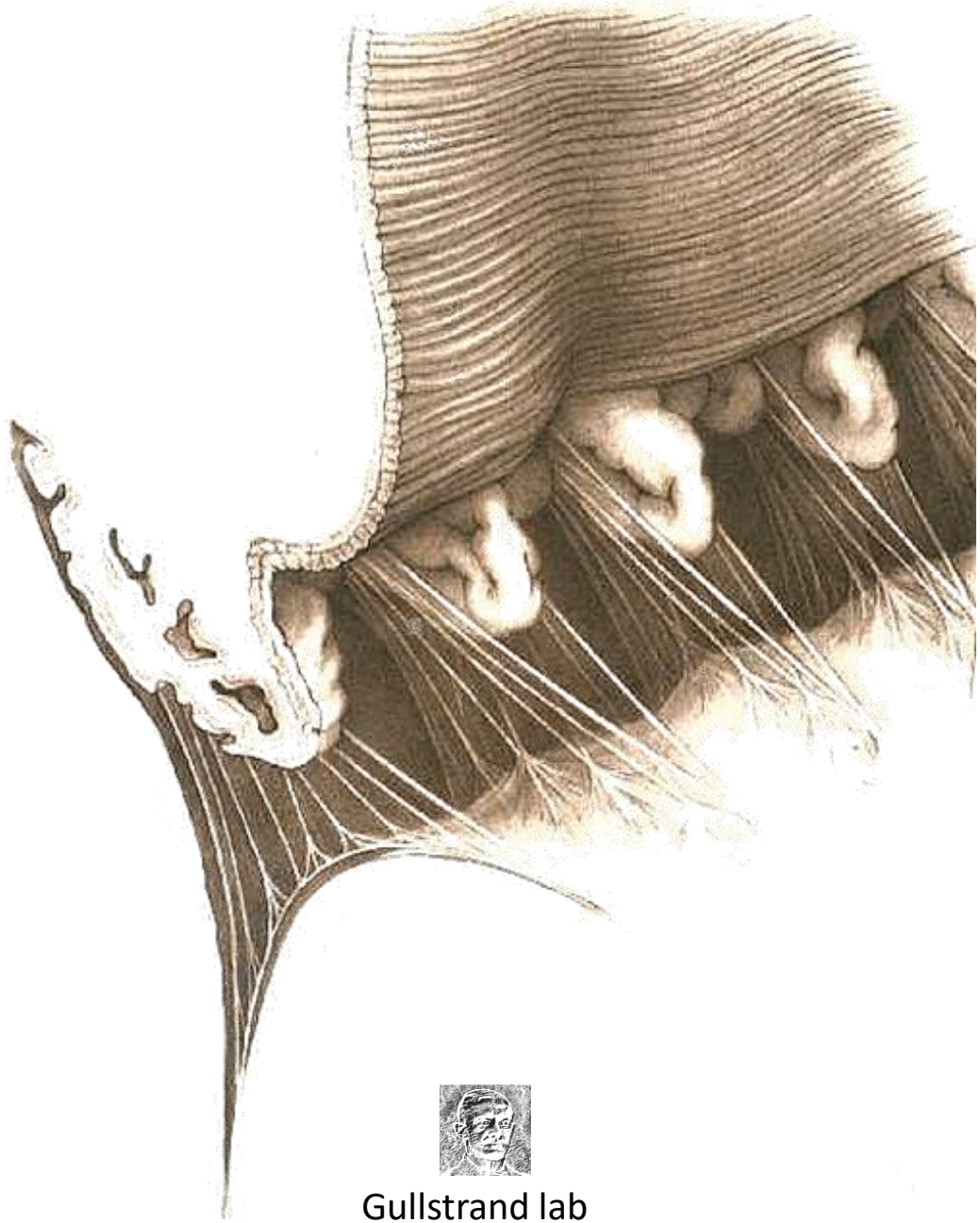
Makroscopic anatomy - Zonules

Makroscopic anatomy - Zonules



Macroscopic anatomy – Lens suspension



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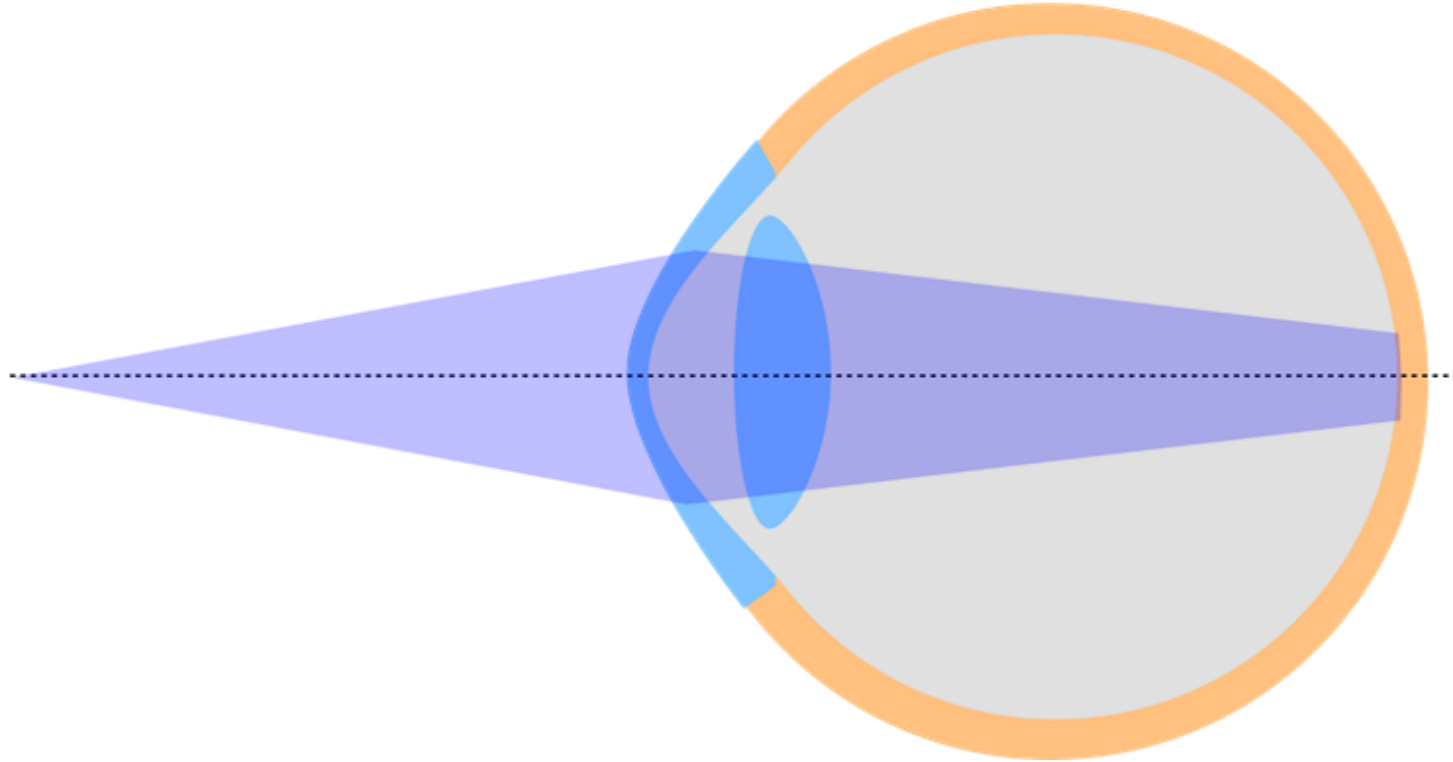
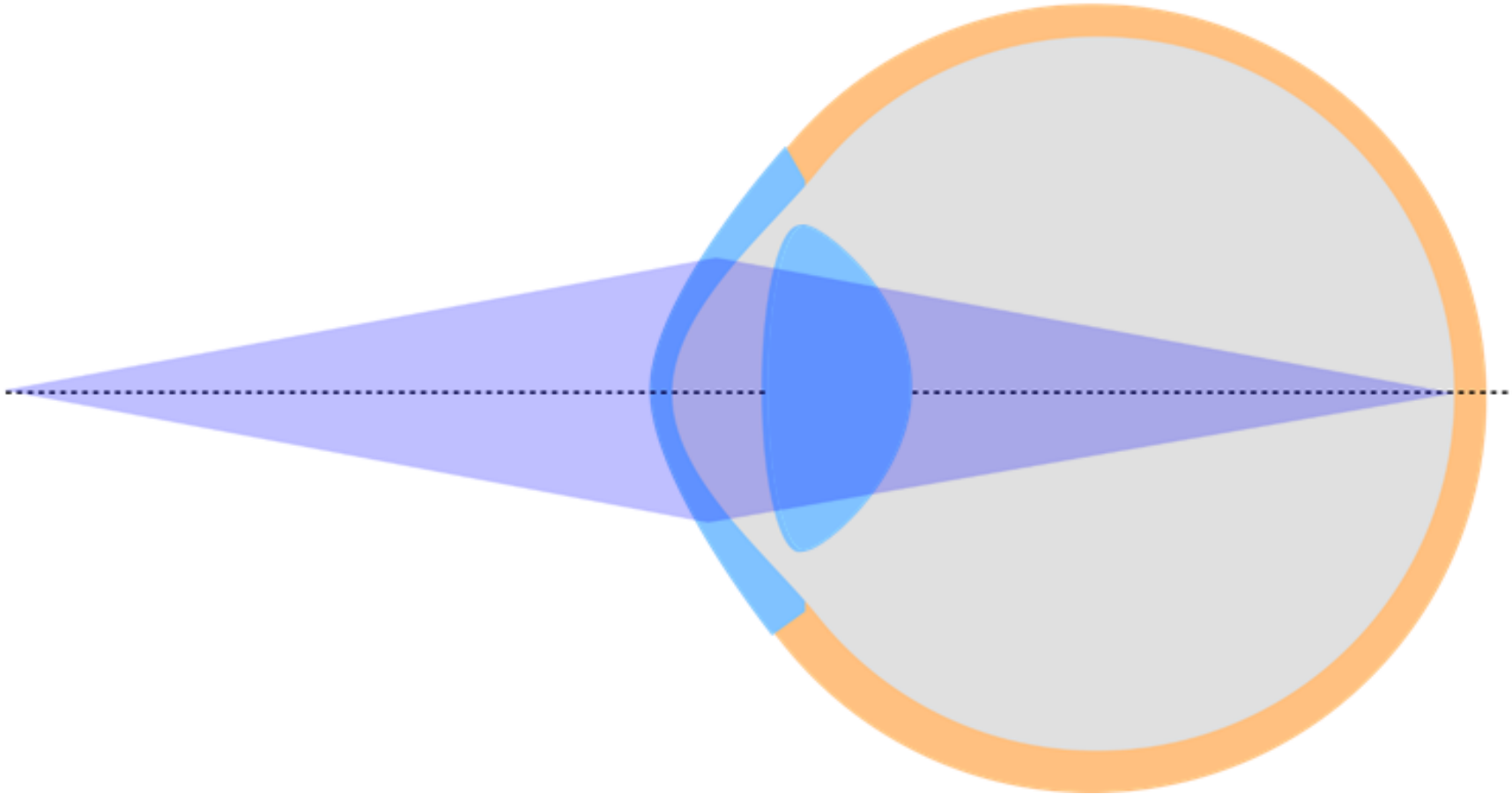
Natural Crystalline Lens Stretching.
Slit Lamp : Thickness Measurements
Ophthalmic
Biophysics
Center
Ciliary body diameter
Time

Emmetropic eye, vision at close distance

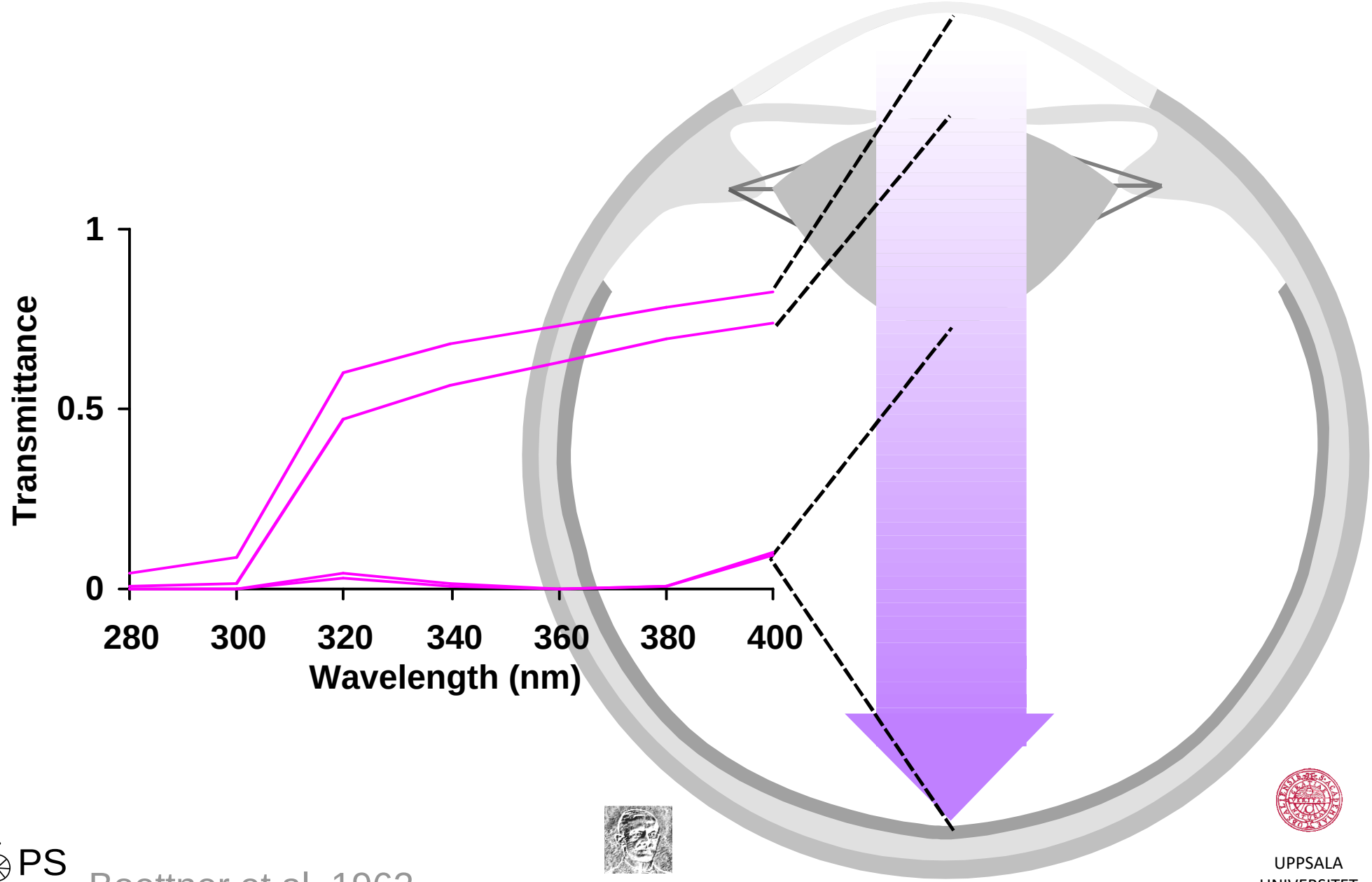


Ackommodation

Adjustment of the optics of the eye for vision at close distance



Transmittance, eye ultraviolet radiation (UVR)



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Boettner et al, 1962

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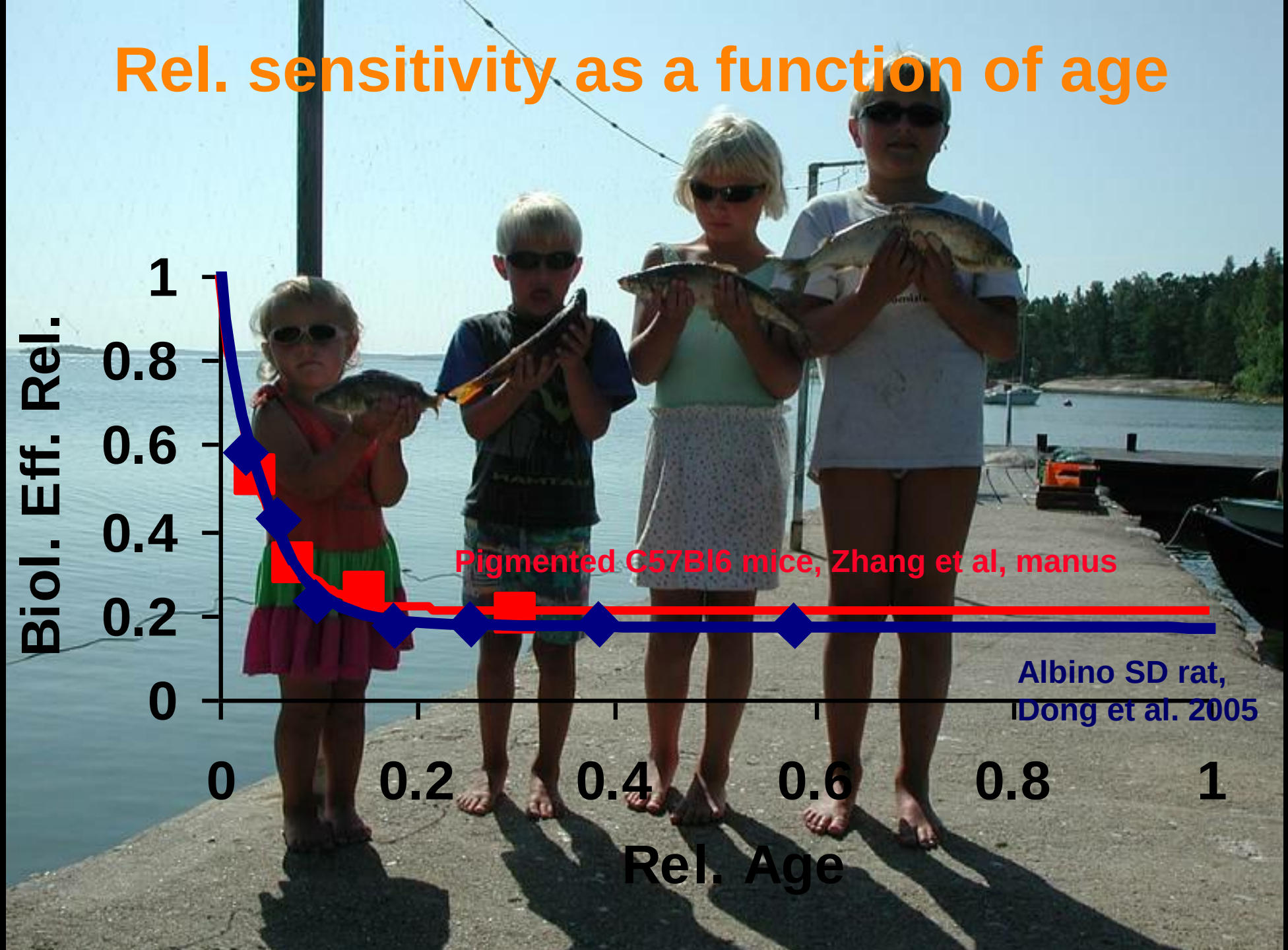
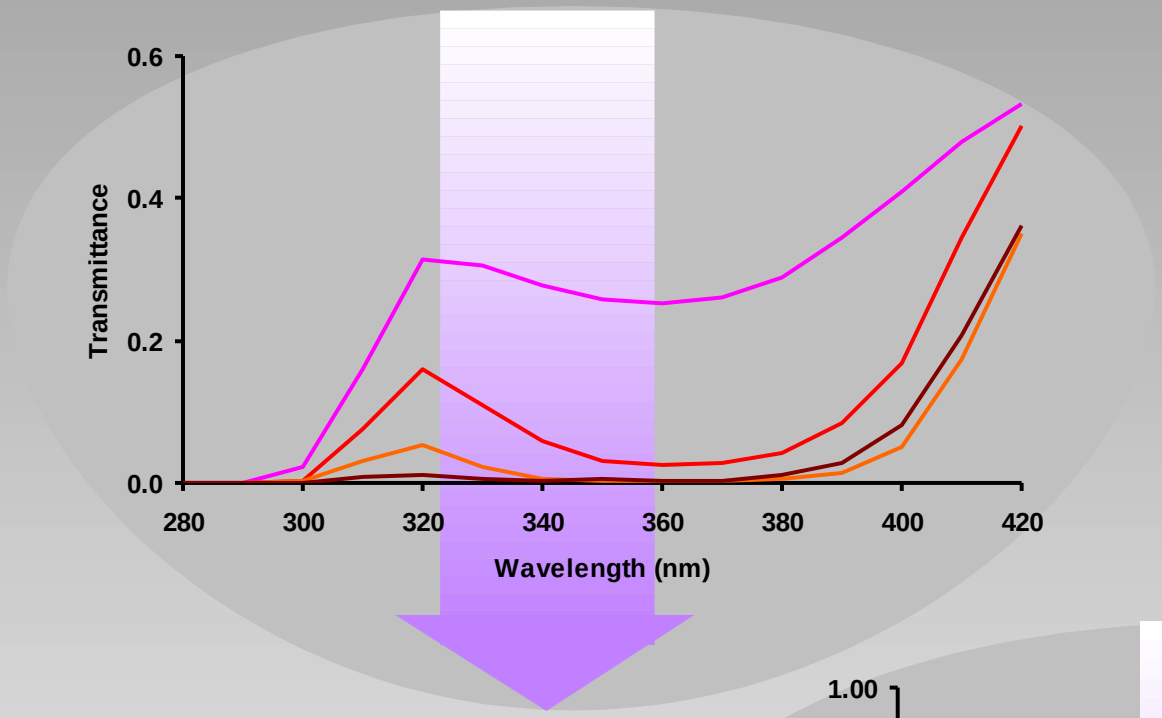
Rel. sensitivity as a function of age



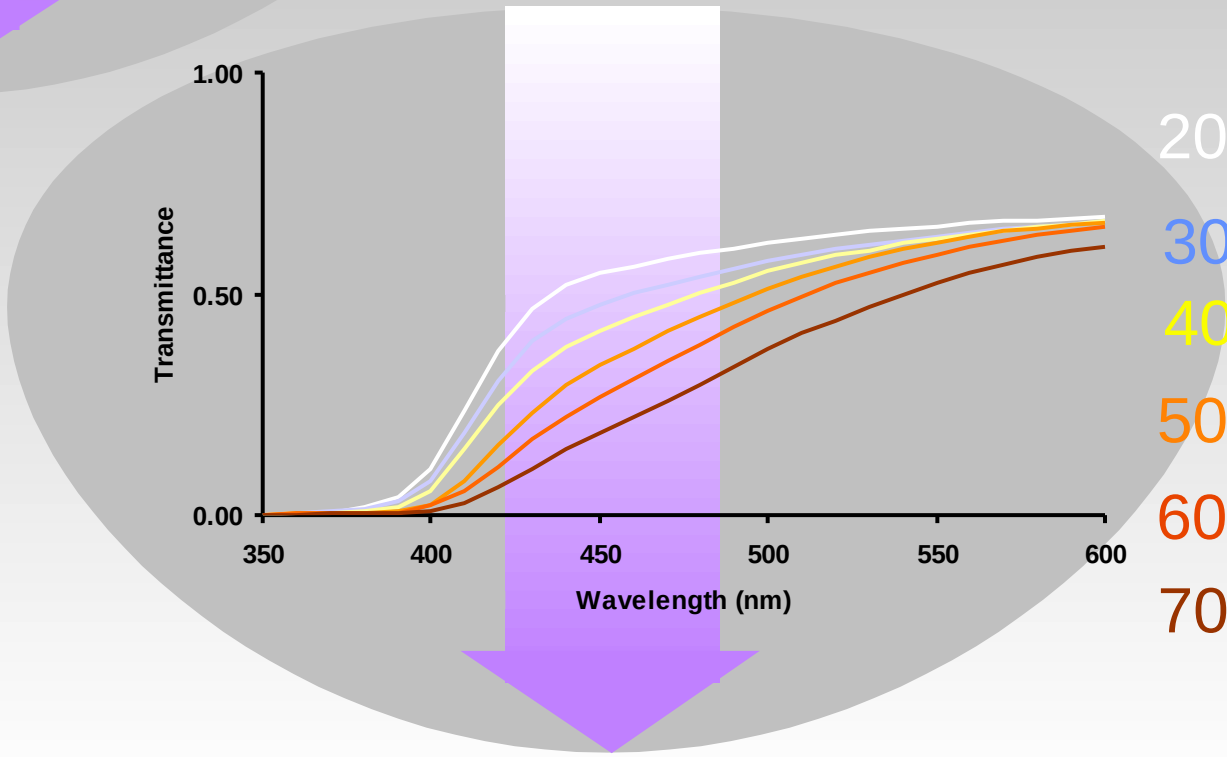


Prenatal

Birth

0-2 yrs

10-19 yrs



20-29 yrs

30-39 yrs

40-49 yrs

50-59 yrs

60-69 yrs

70-79 yrs

WHO, 1994

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Macular protection with IOLs

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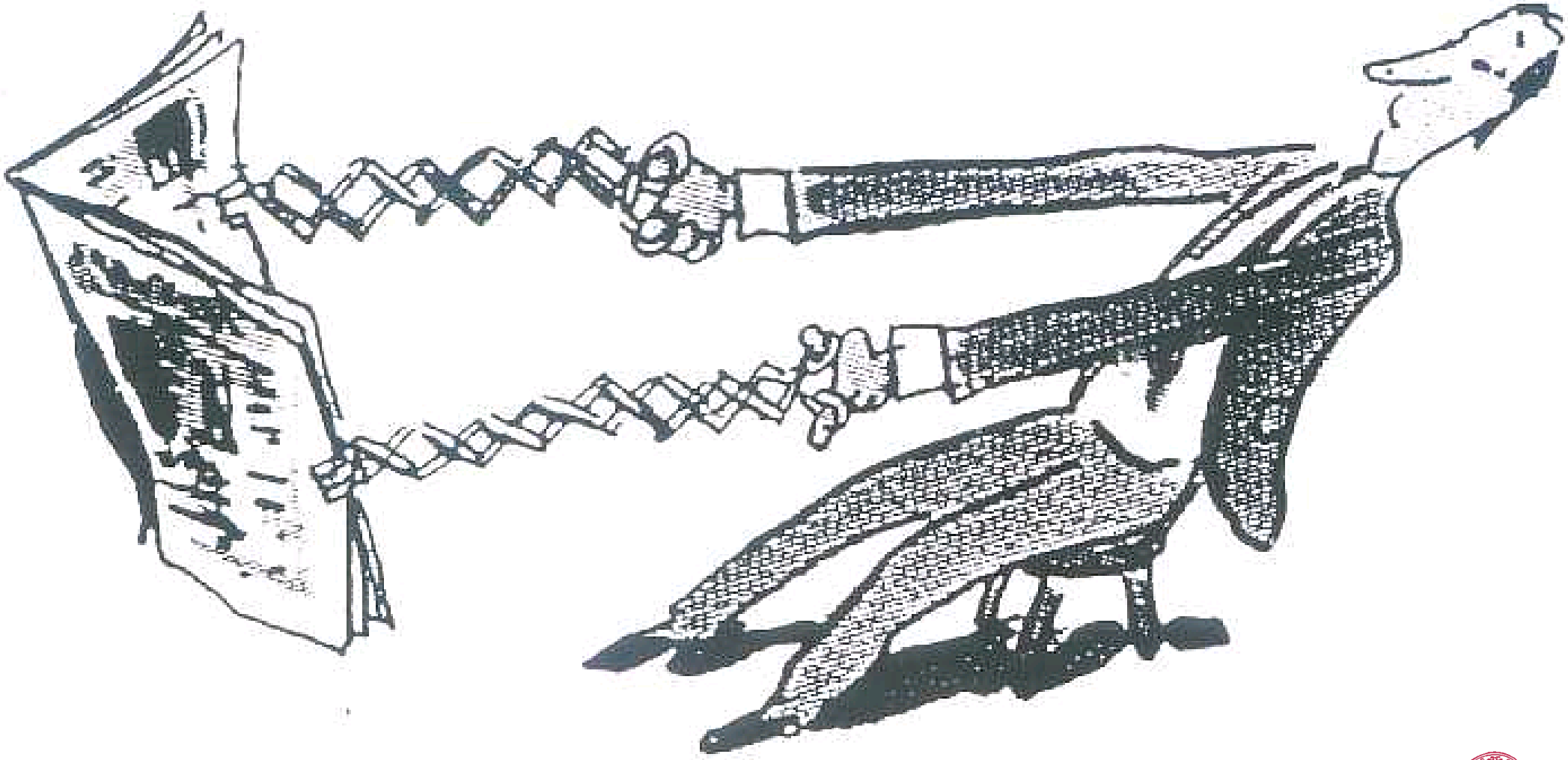
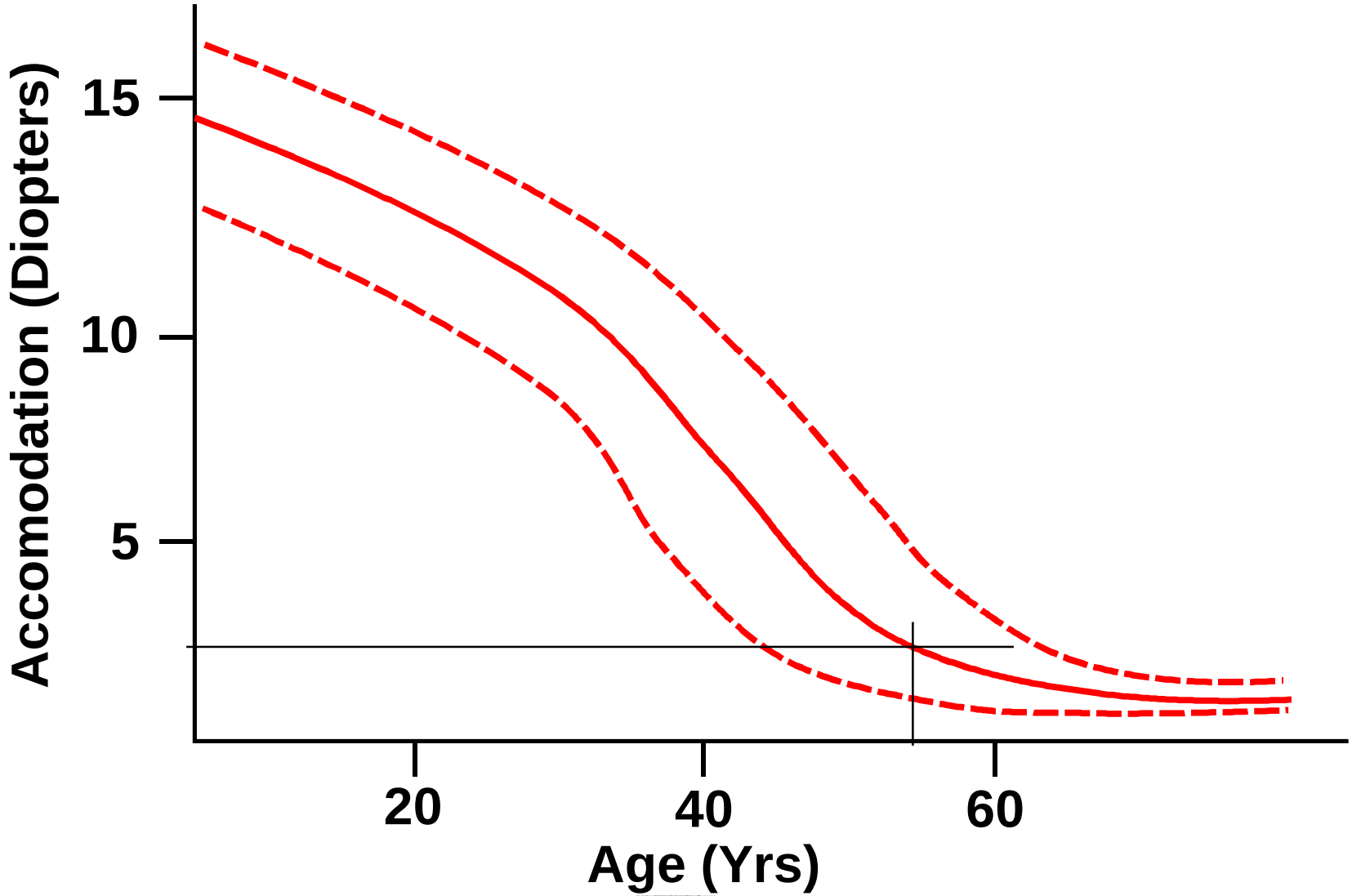
Pathology of the lens - Presbyopia



Ackommodation versus age



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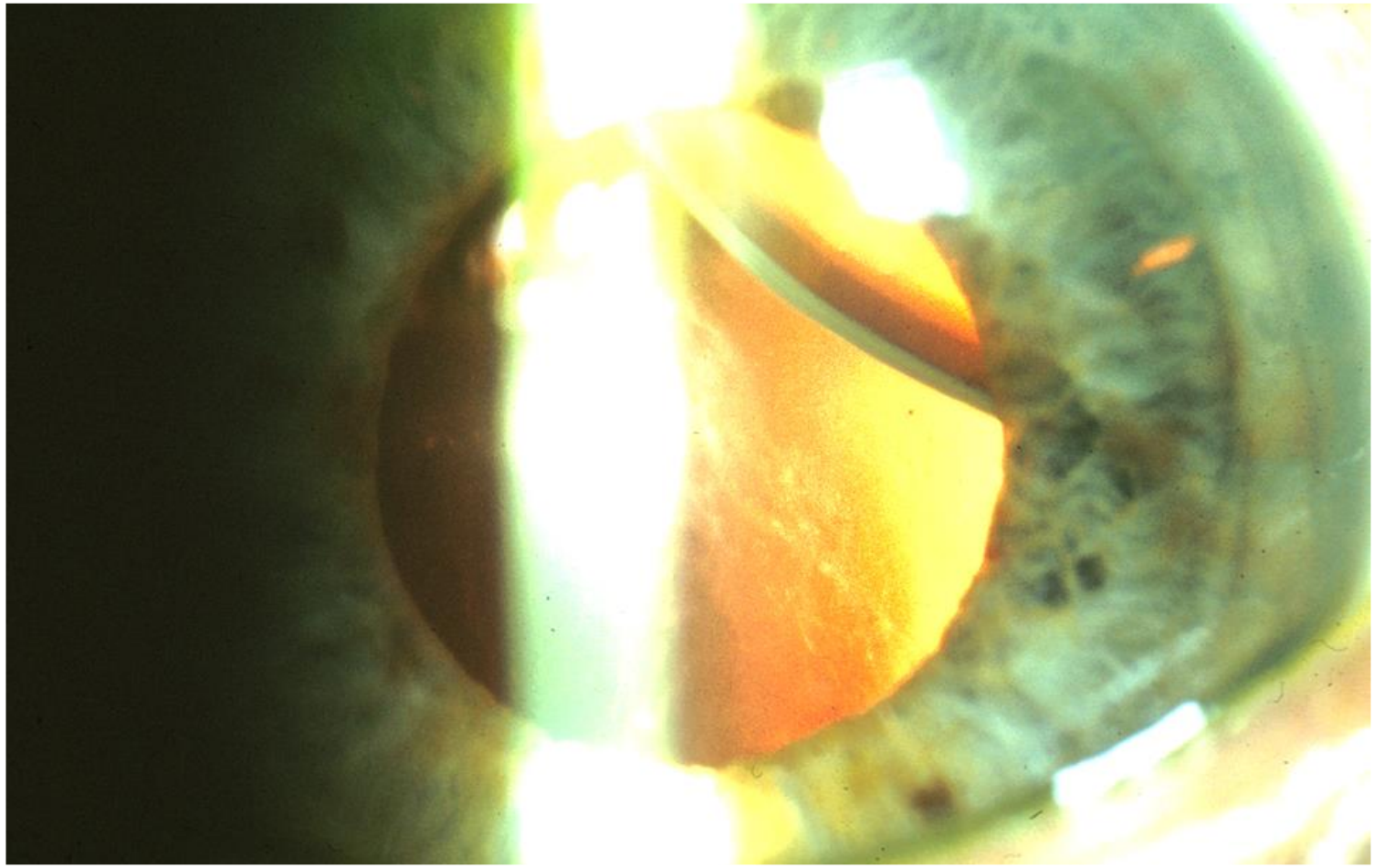
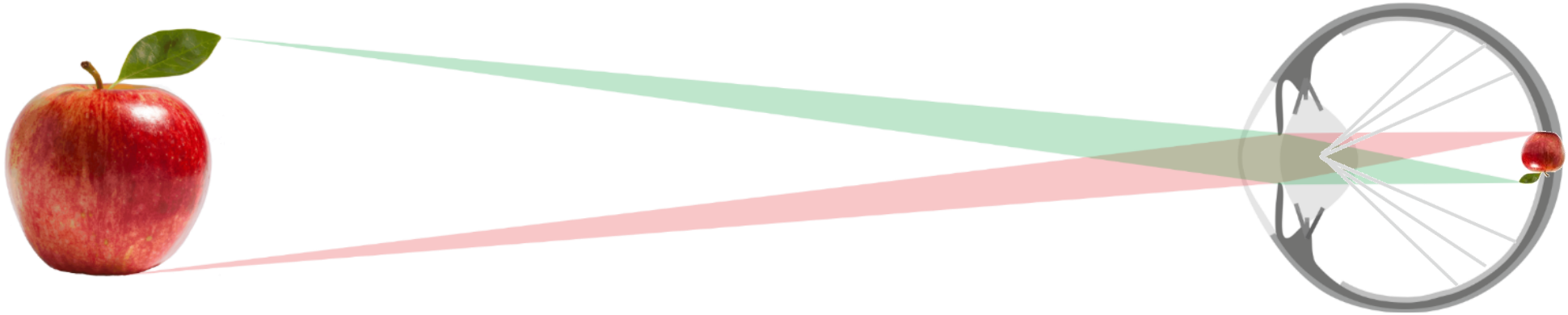
Pathology of the lens - Lens luxation



Marfan syndrom!

Cataract - Clinical definition

Light scattering in the lens causing visual disturbance



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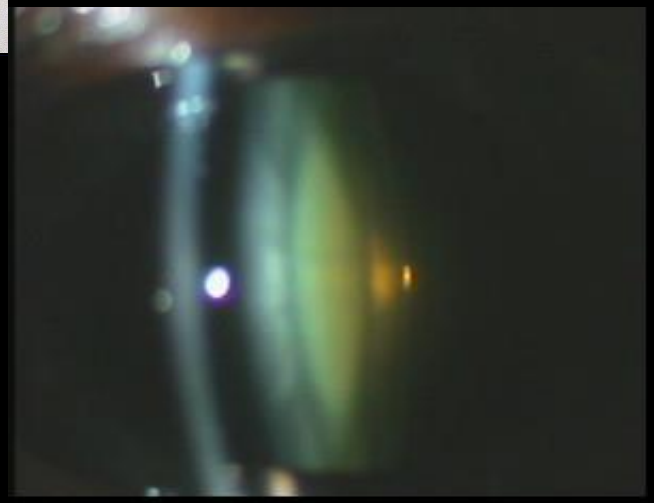
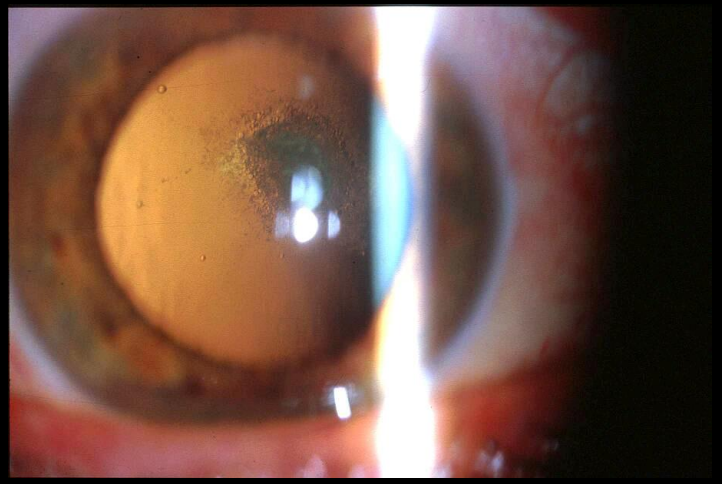
Cataract

Cortical

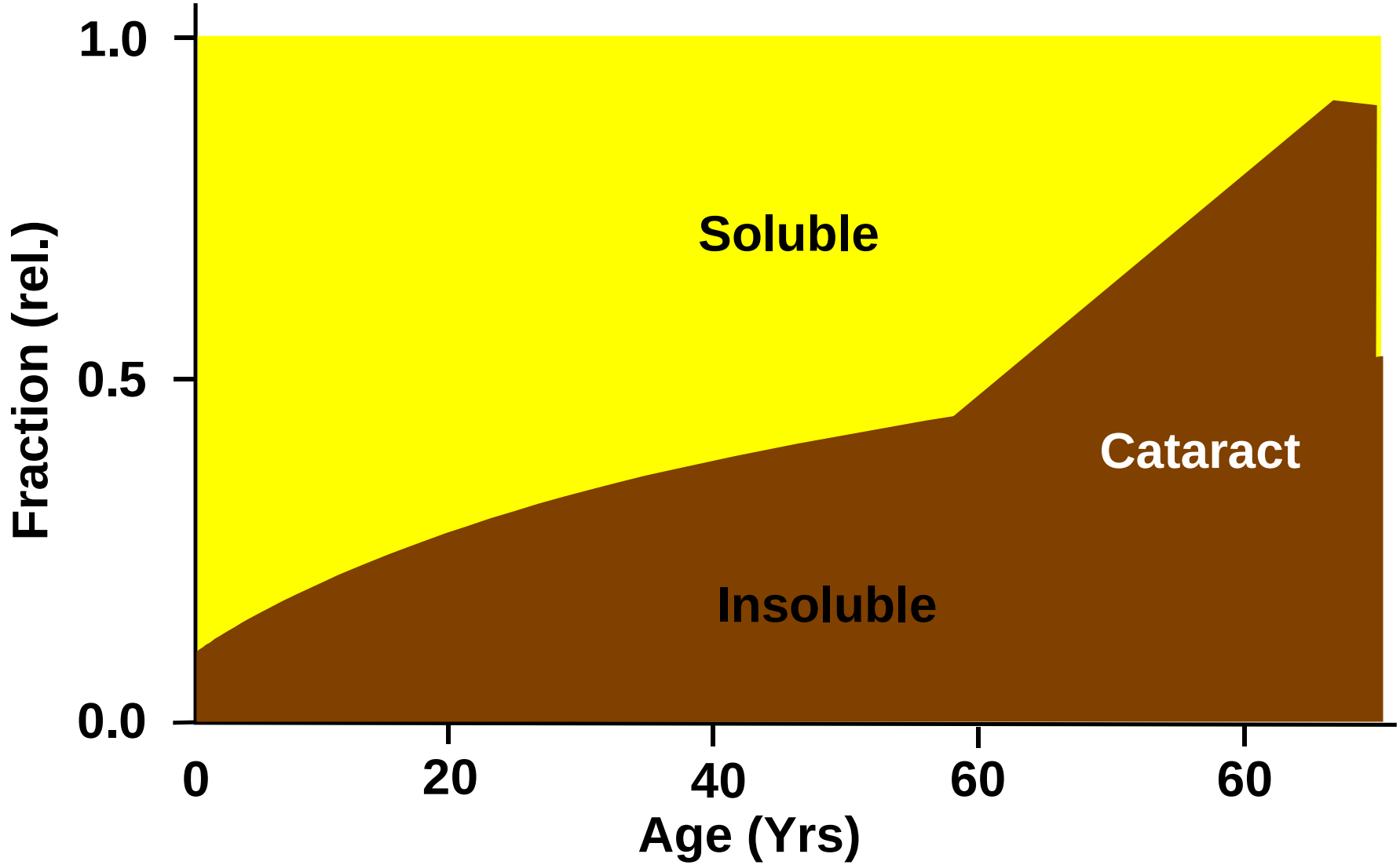


Nuclear

Posterior subcapsular



Soluble and insoluble proteins and cataract development



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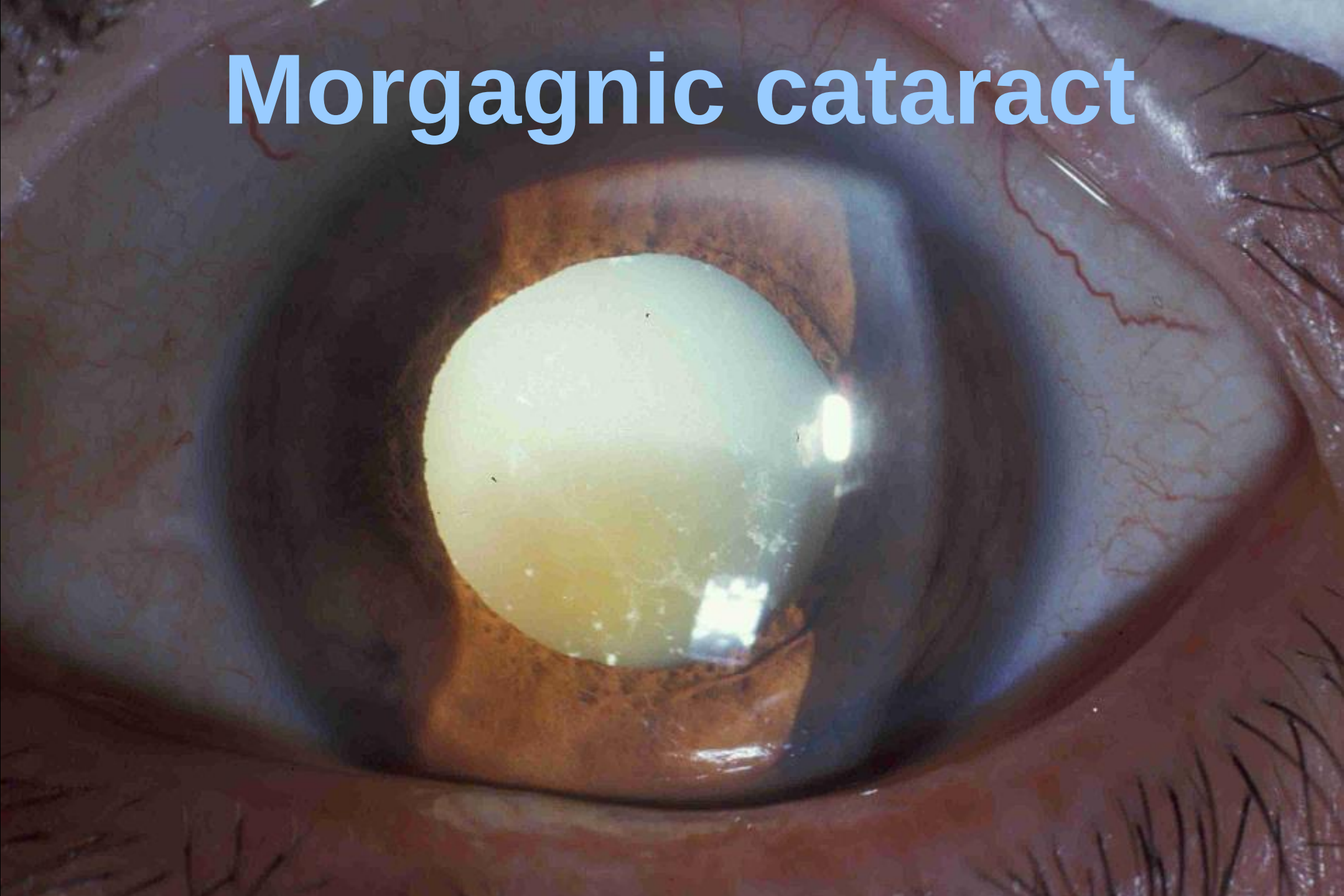
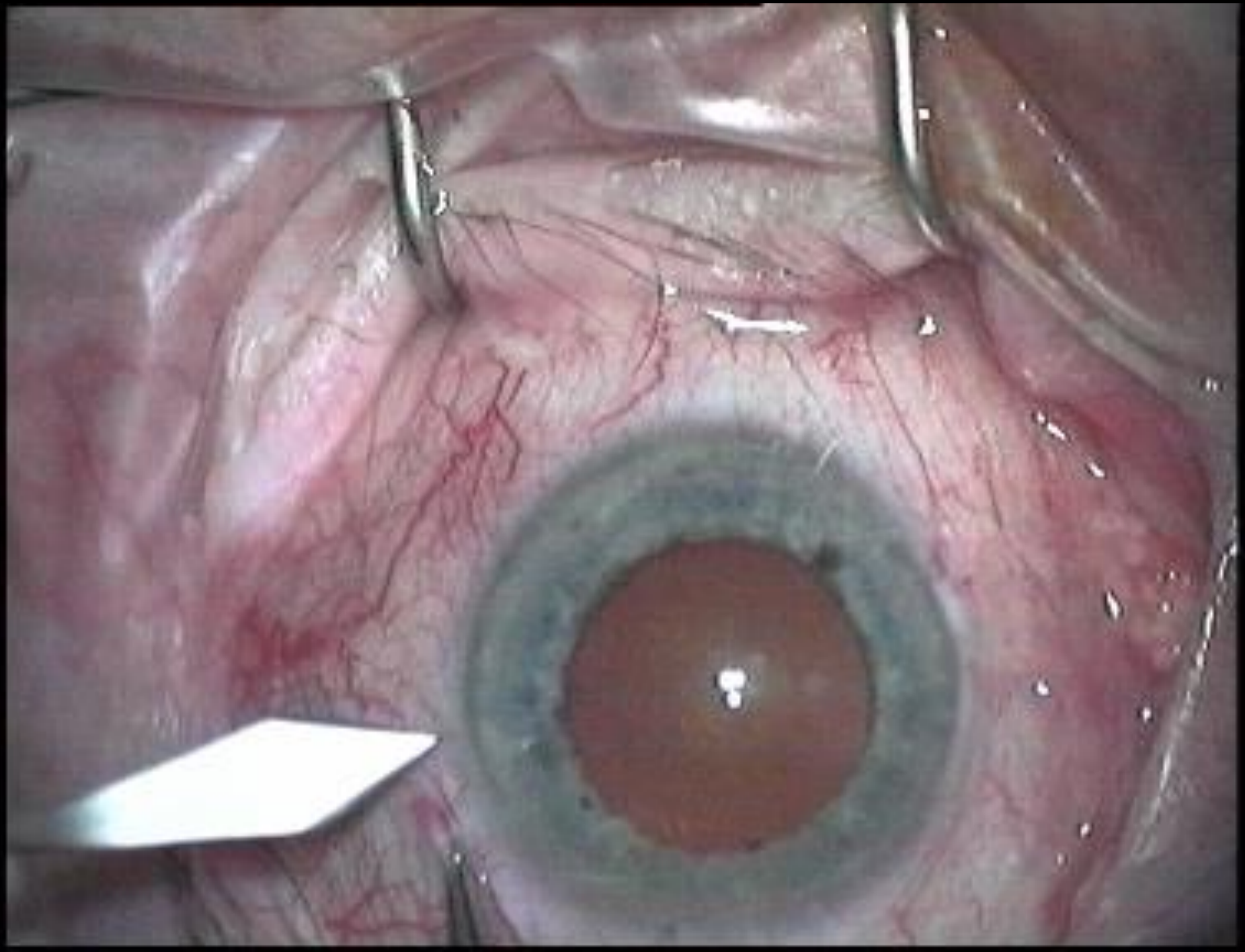
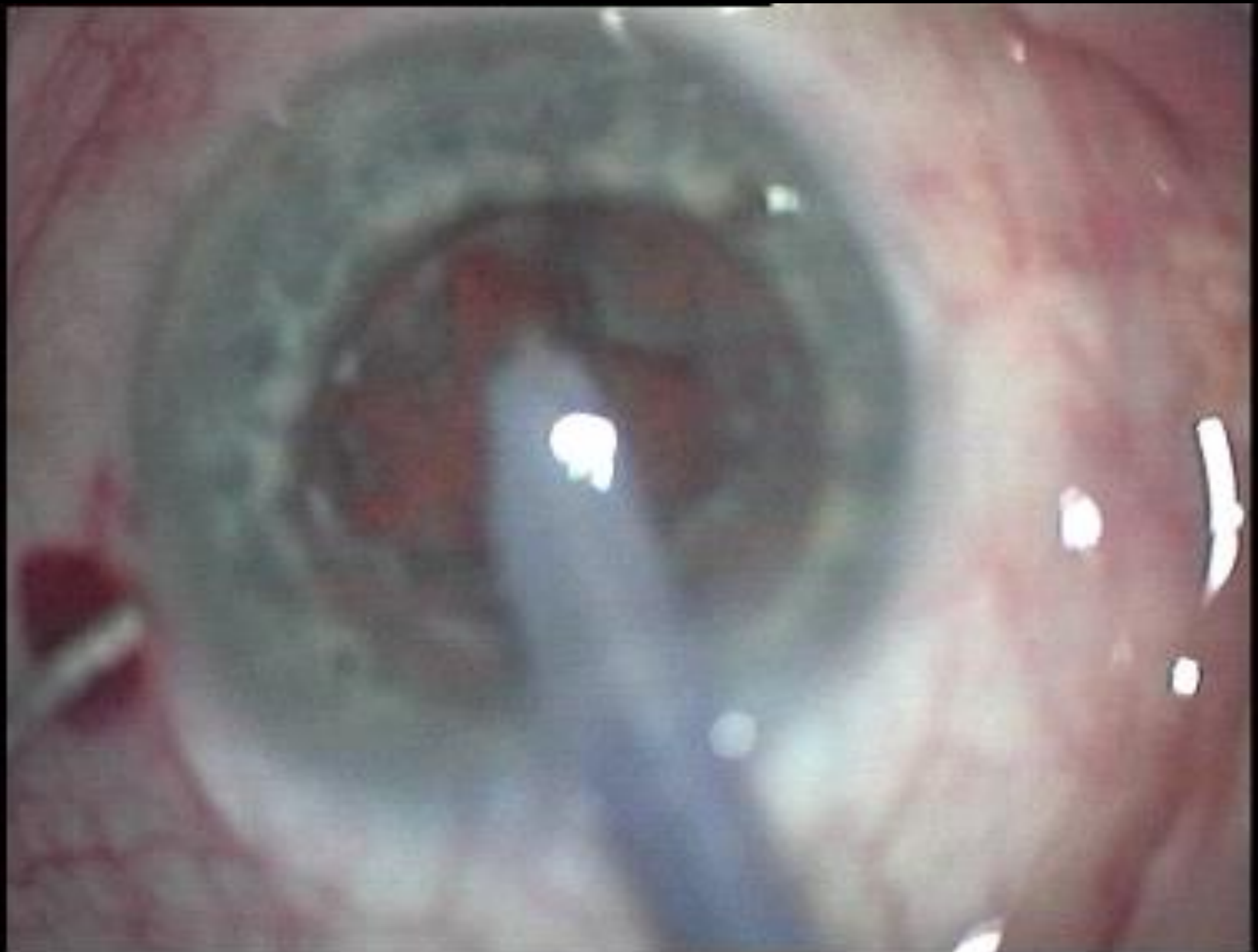
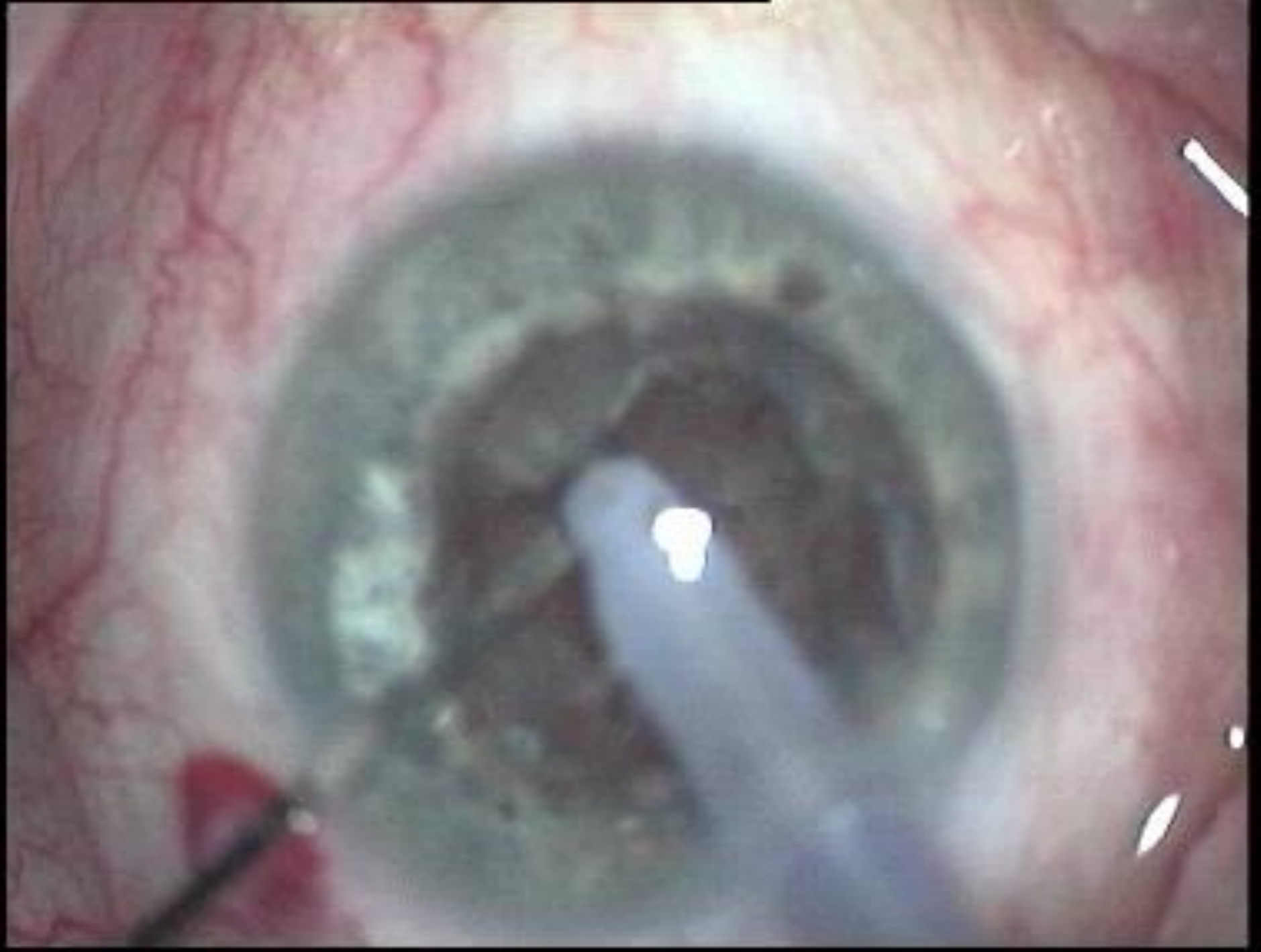
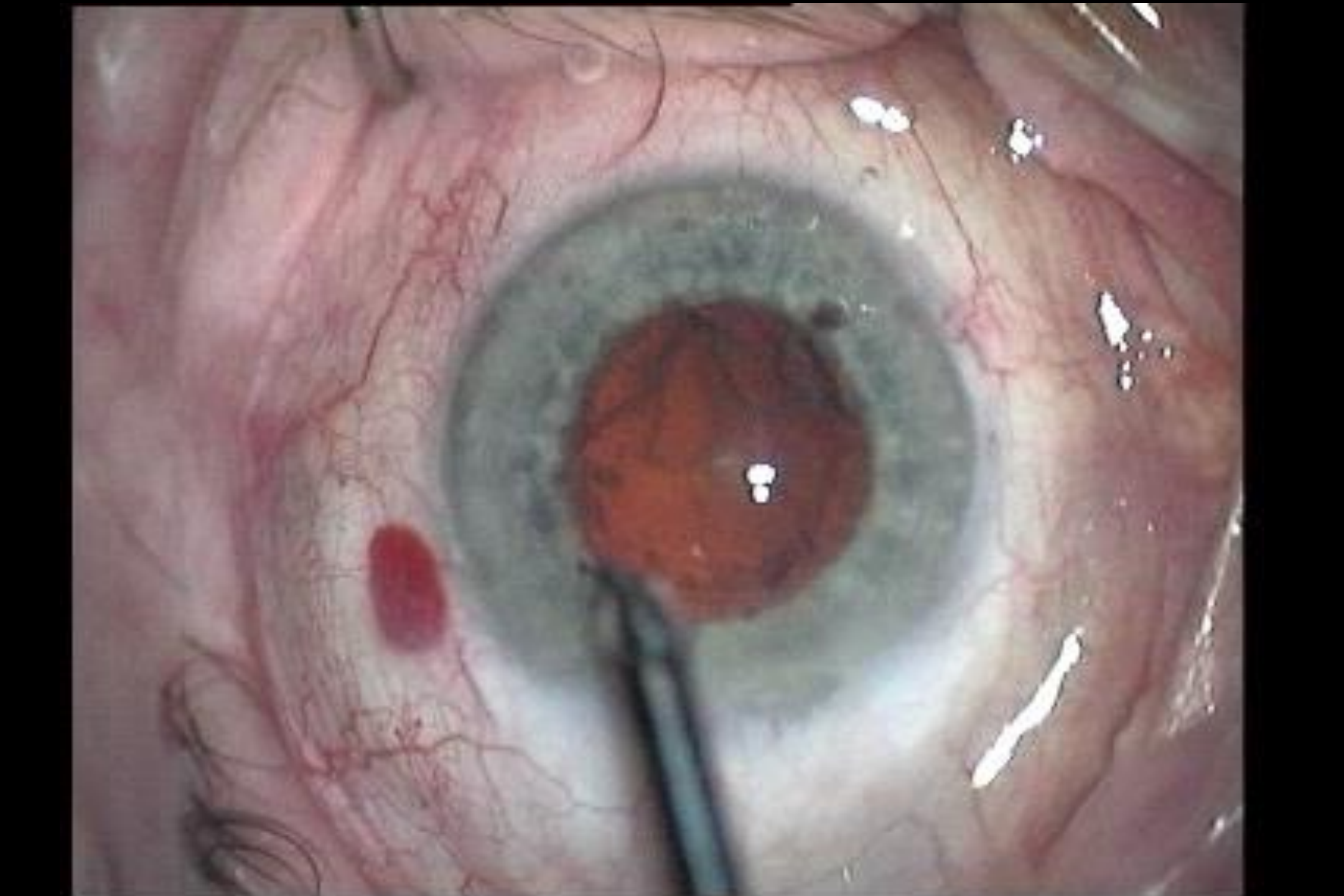
Morgagnic cataract

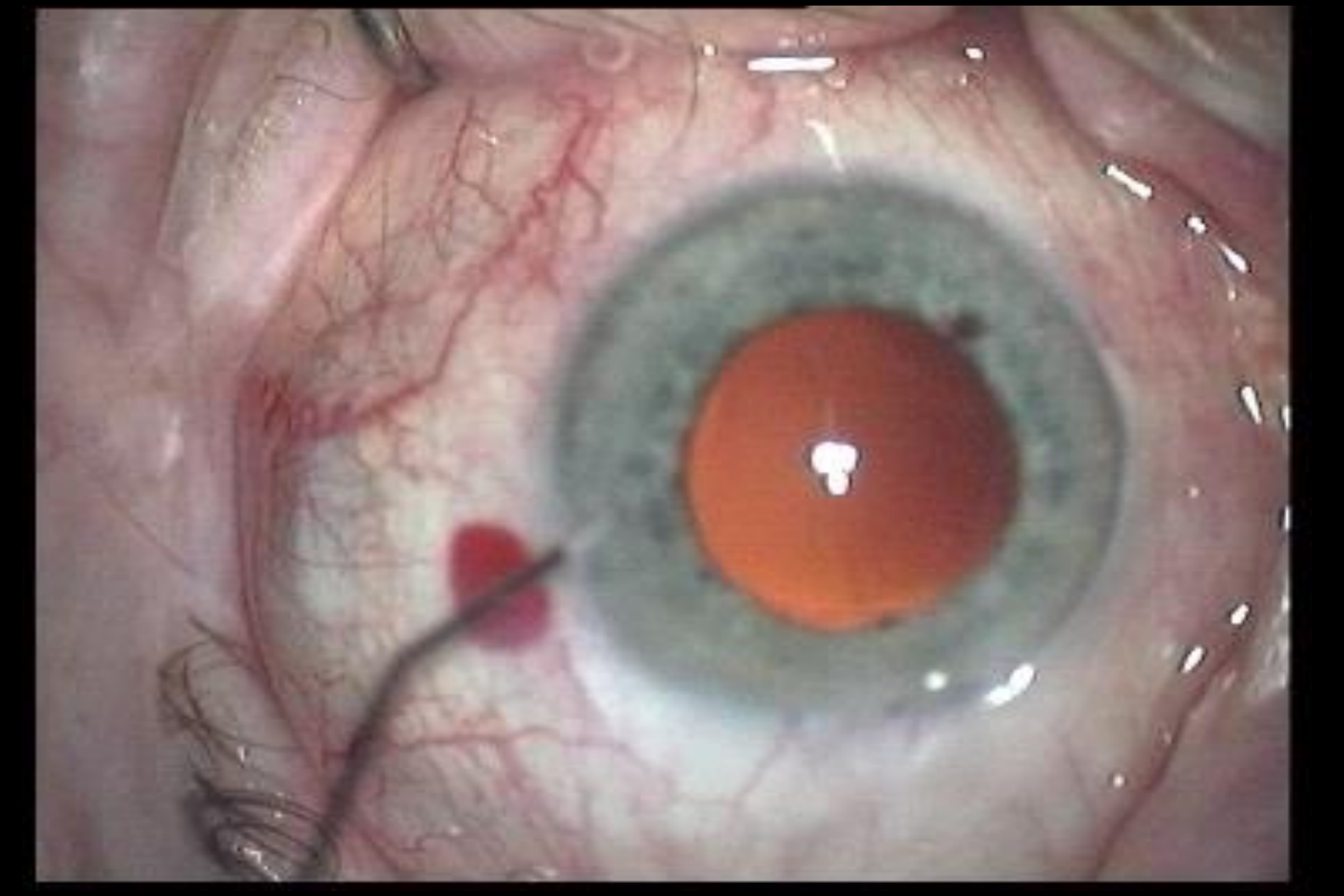


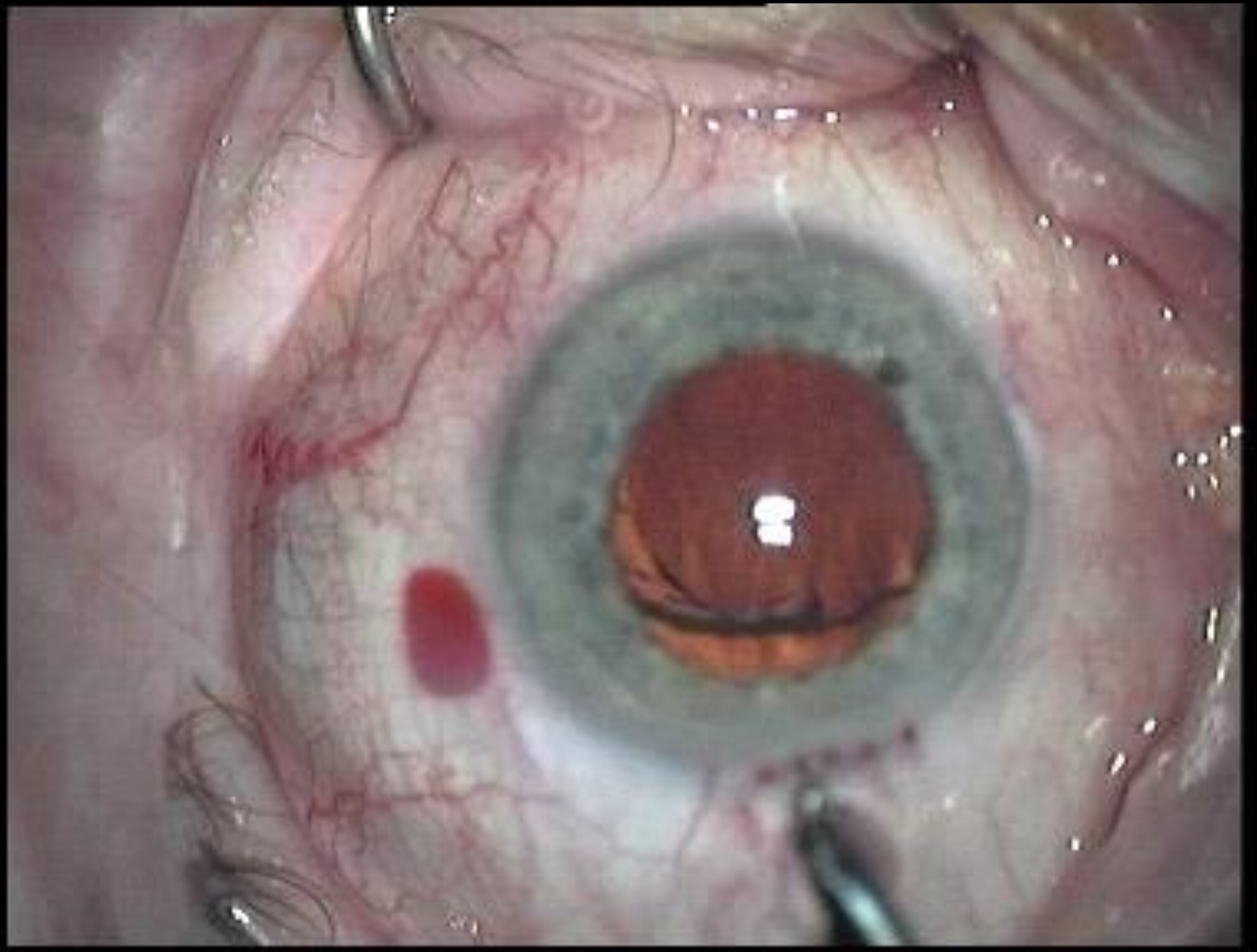


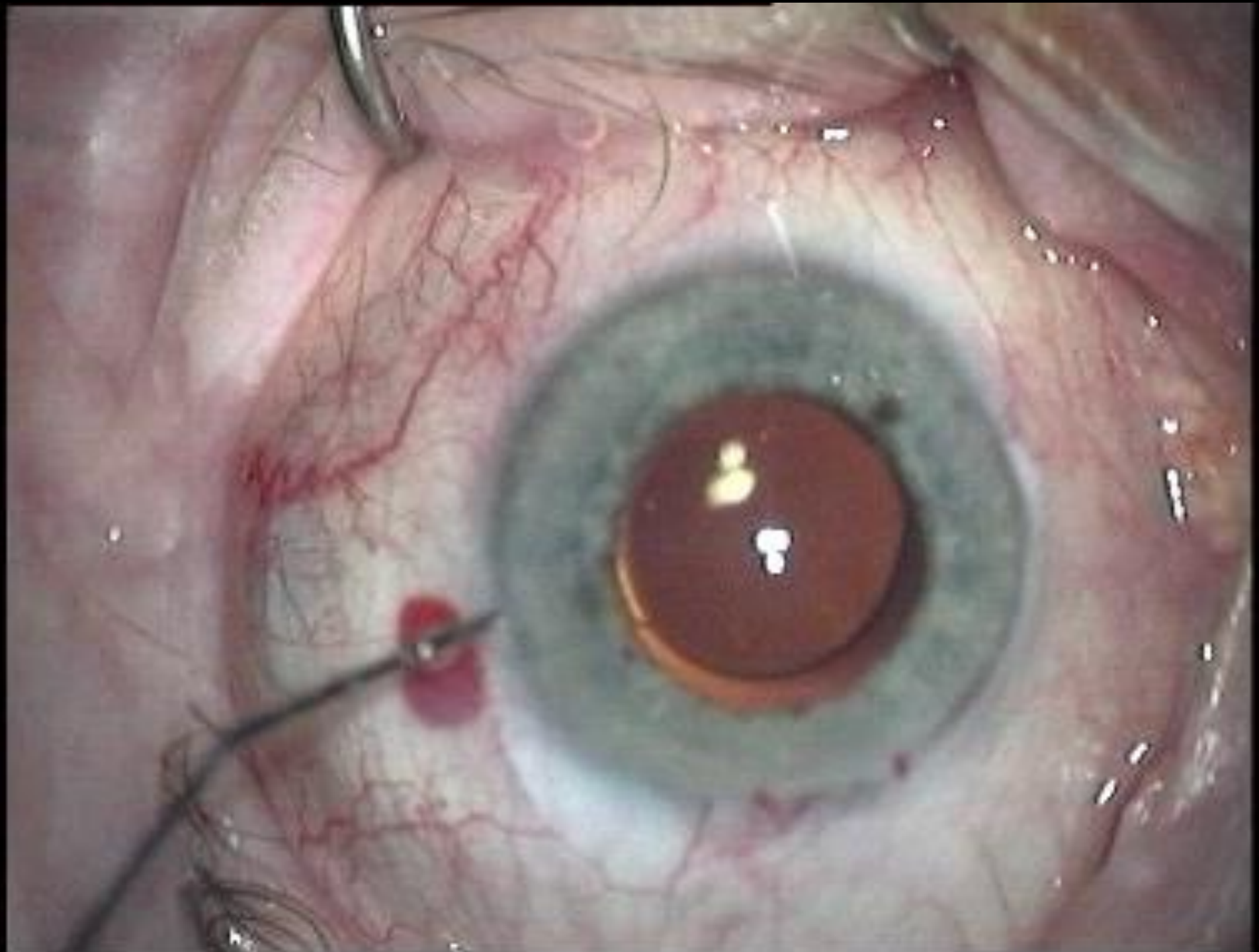




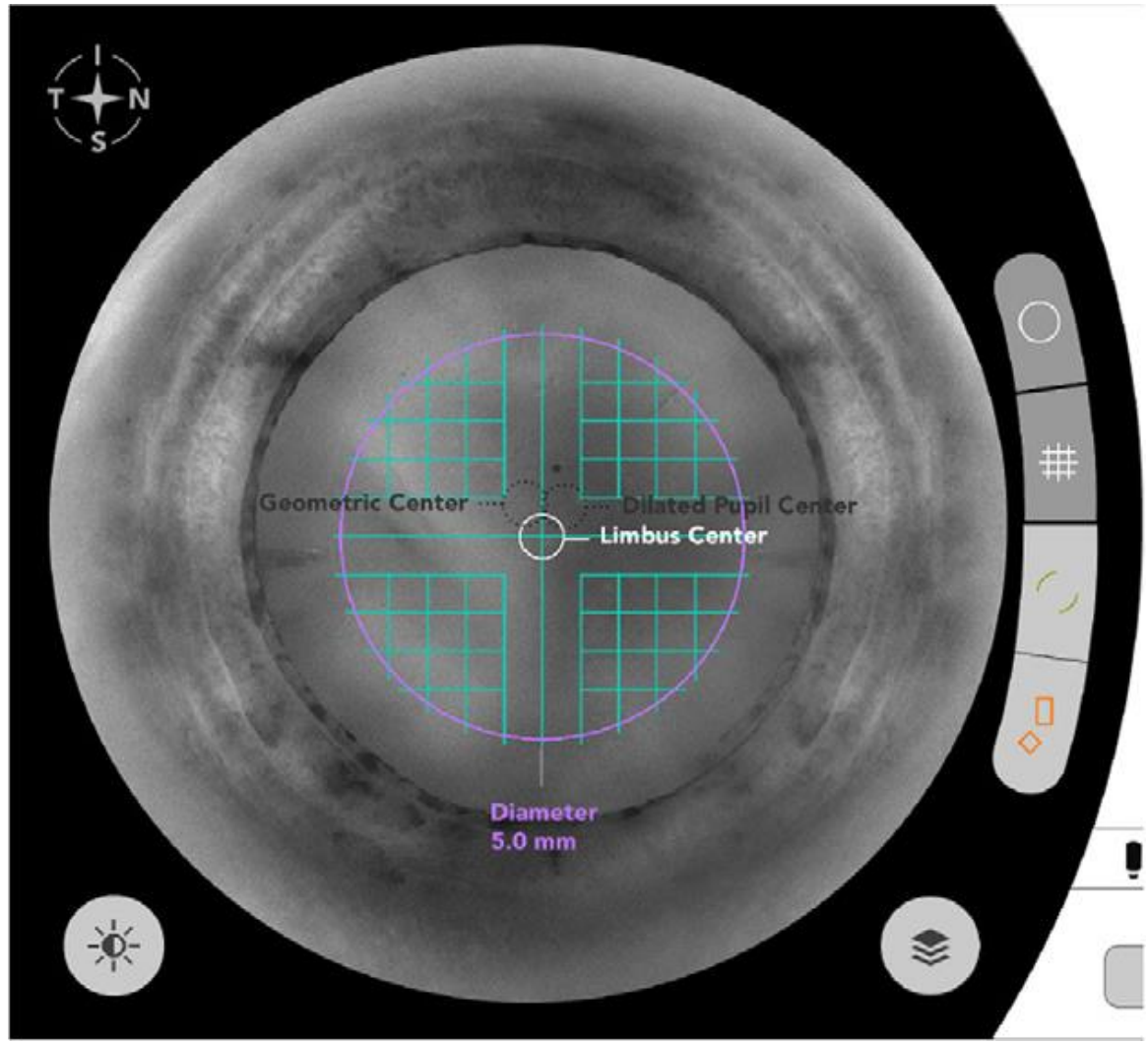








Preparation for fs cataract surgery



Gullstrand lab

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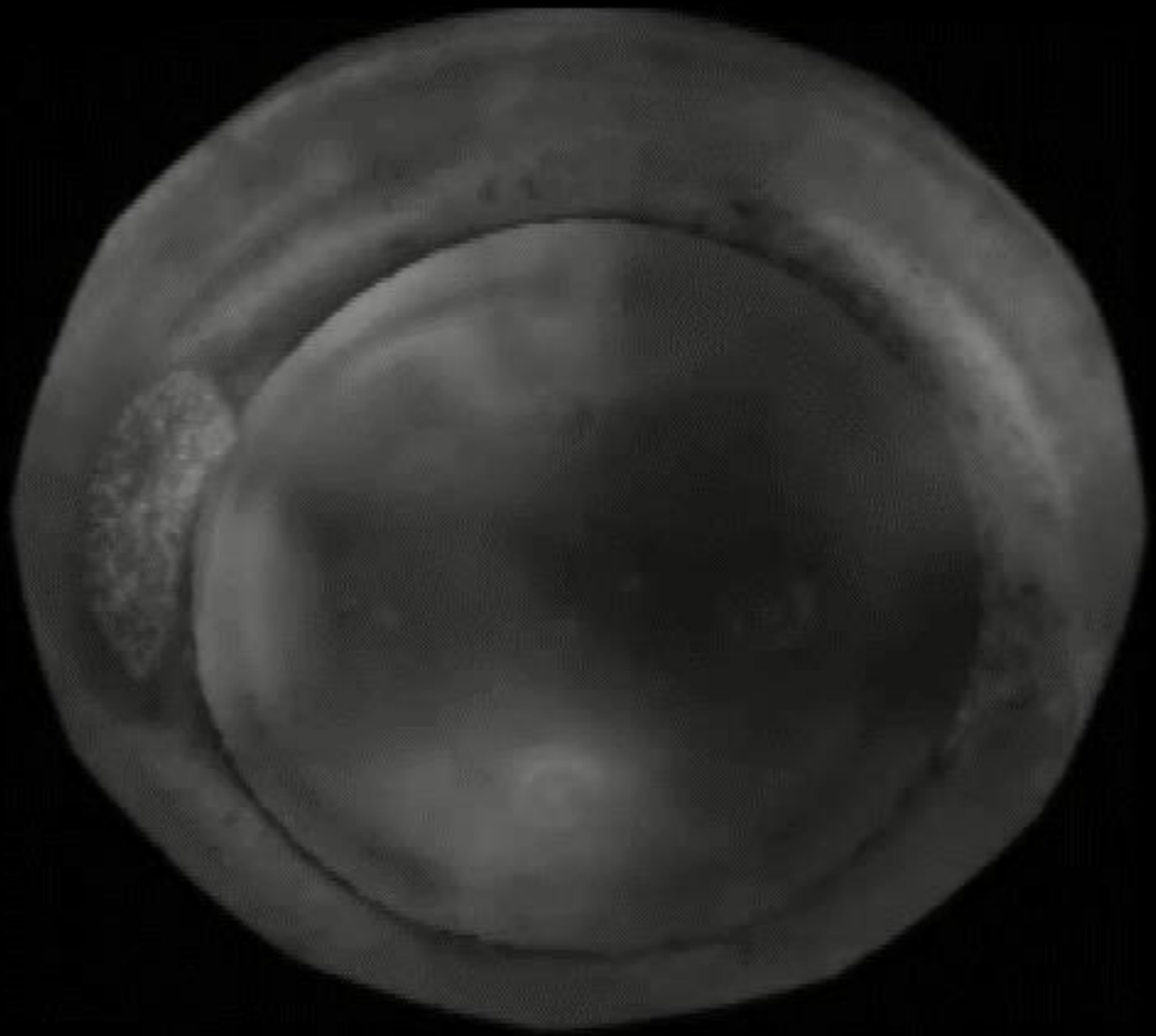


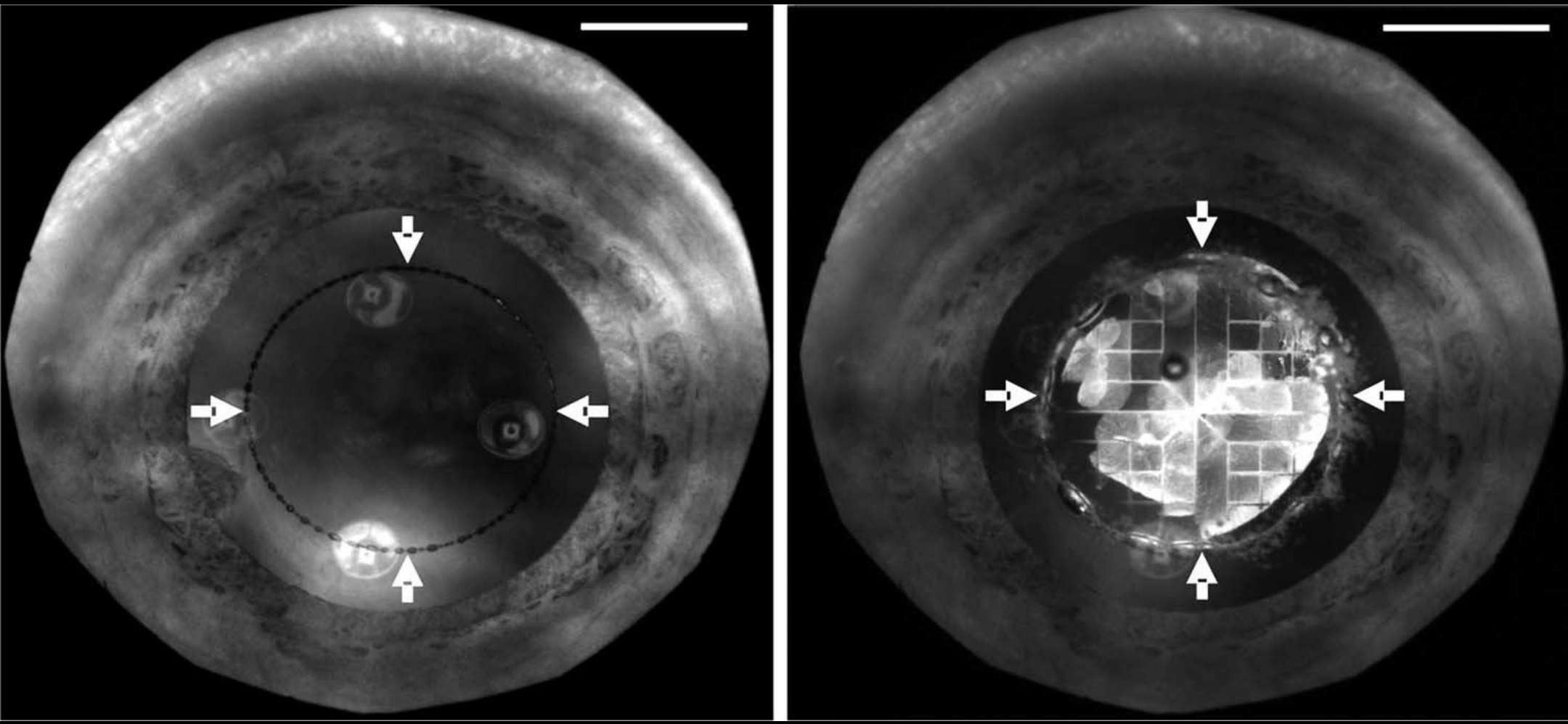
Courtesy Daniel Palanker, Stanford Univ.

fs cuts in crystalline lens

Capsulorhexis

After

Lens cuts



Palanker et al., 2010