



**Contact lens Assisted CXL (CACXL):
Technique for Accelerated Cross Linking of thin corneas
(ACACXL)**

DR. SOOSAN JACOB, MS, FRCS, DNB

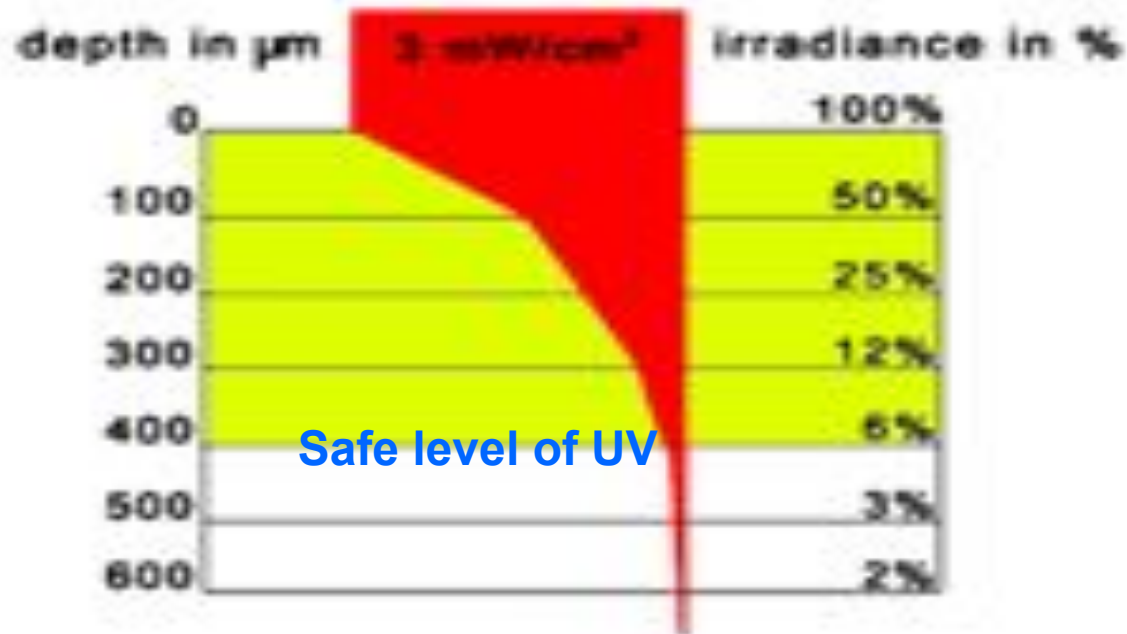
Director and Head

Dr. Agarwal's Refractive & Cornea Foundation (DARCF)

DR. AGARWAL'S EYE HOSPITAL, CHENNAI, INDIA

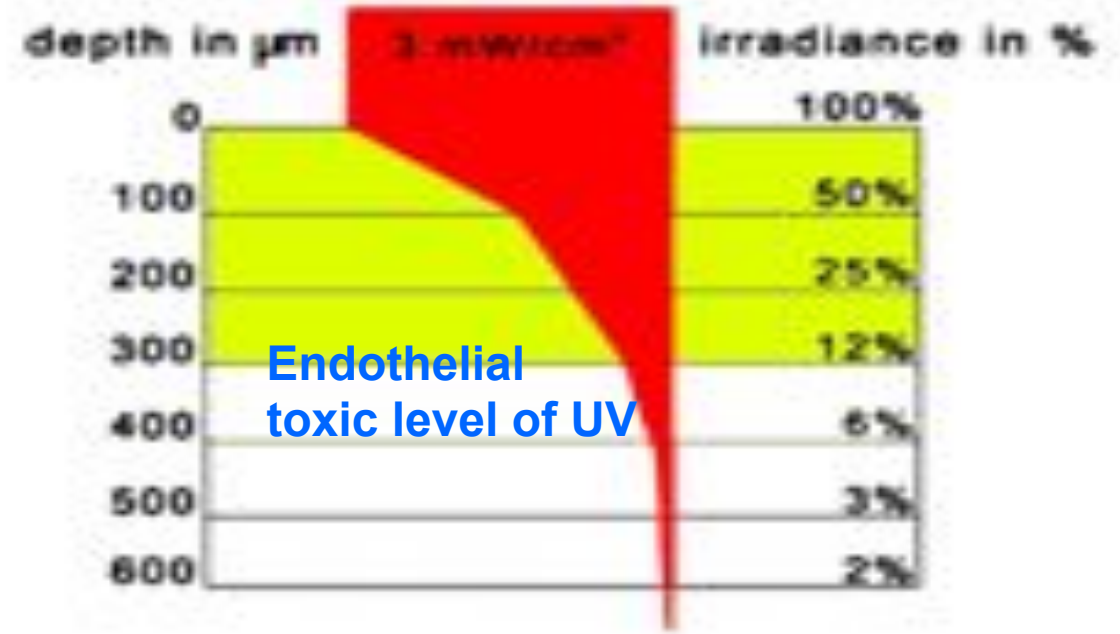
**I do not have any financial interests
in any products or procedures shown**

PRINCIPLE BEHIND CACXL



Anterior stromal UVA absorption with riboflavin

**400 micron Corneal stroma
after epithelial removal**



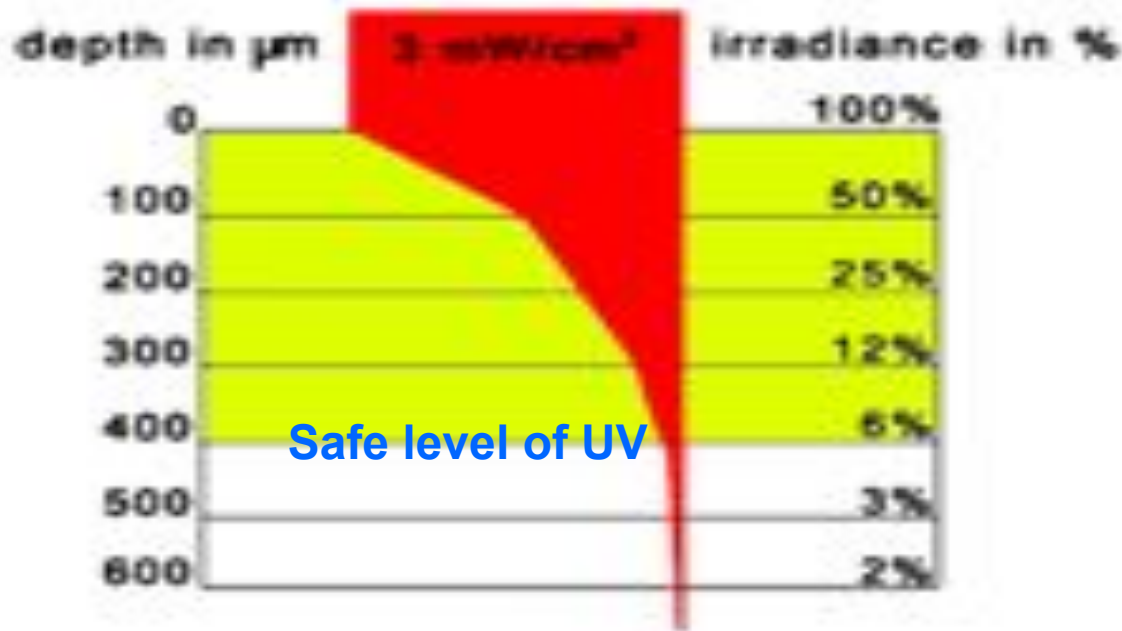
Anterior stromal UVA absorption with riboflavin

**< 400 micron Cornea stroma
after epithelial removal**

(Jacob S et al. Contact lens-assisted collagen cross-linking (CACXL): A new technique for cross-linking thin corneas. J Refract Surg. 2014 Jun;30(6):366-72)

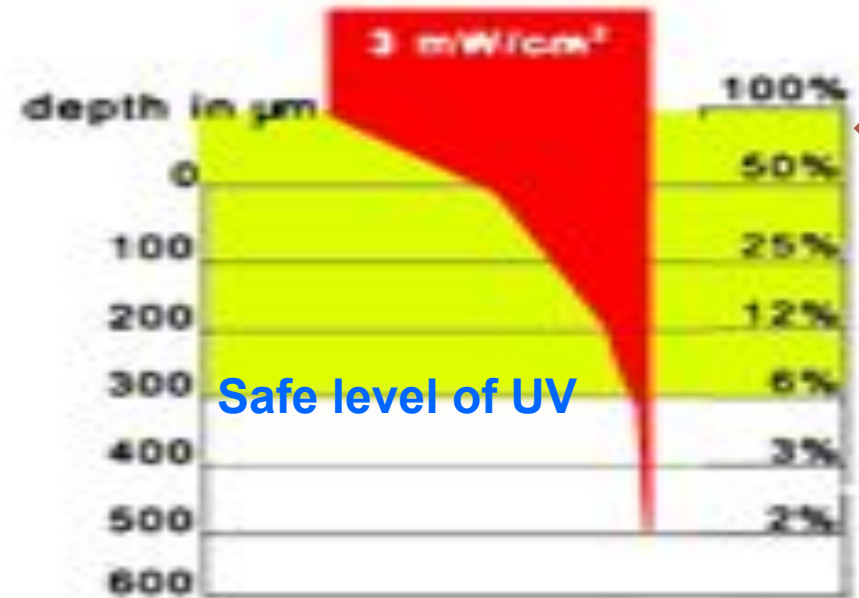
PRINCIPLE BEHIND CACXL

CL gives increased functional thickness



Anterior stromal UVA absorption with riboflavin

400 micron Corneal stroma after epithelial removal



Anterior stromal UVA absorption with riboflavin

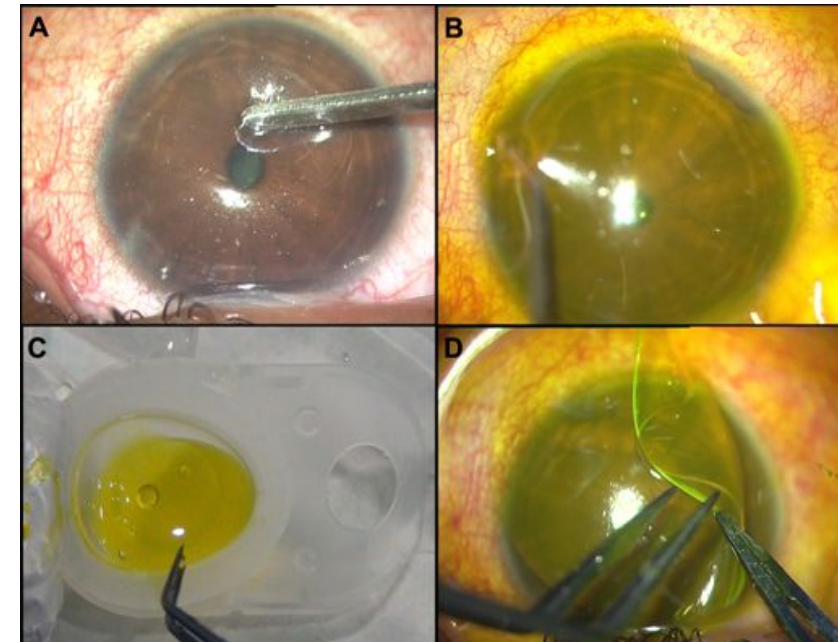
< 400 micron Cornea: CL assisted increased functional thickness

Lambert's law: Each unit layer of a solution absorbs an equal fraction of light passing through it

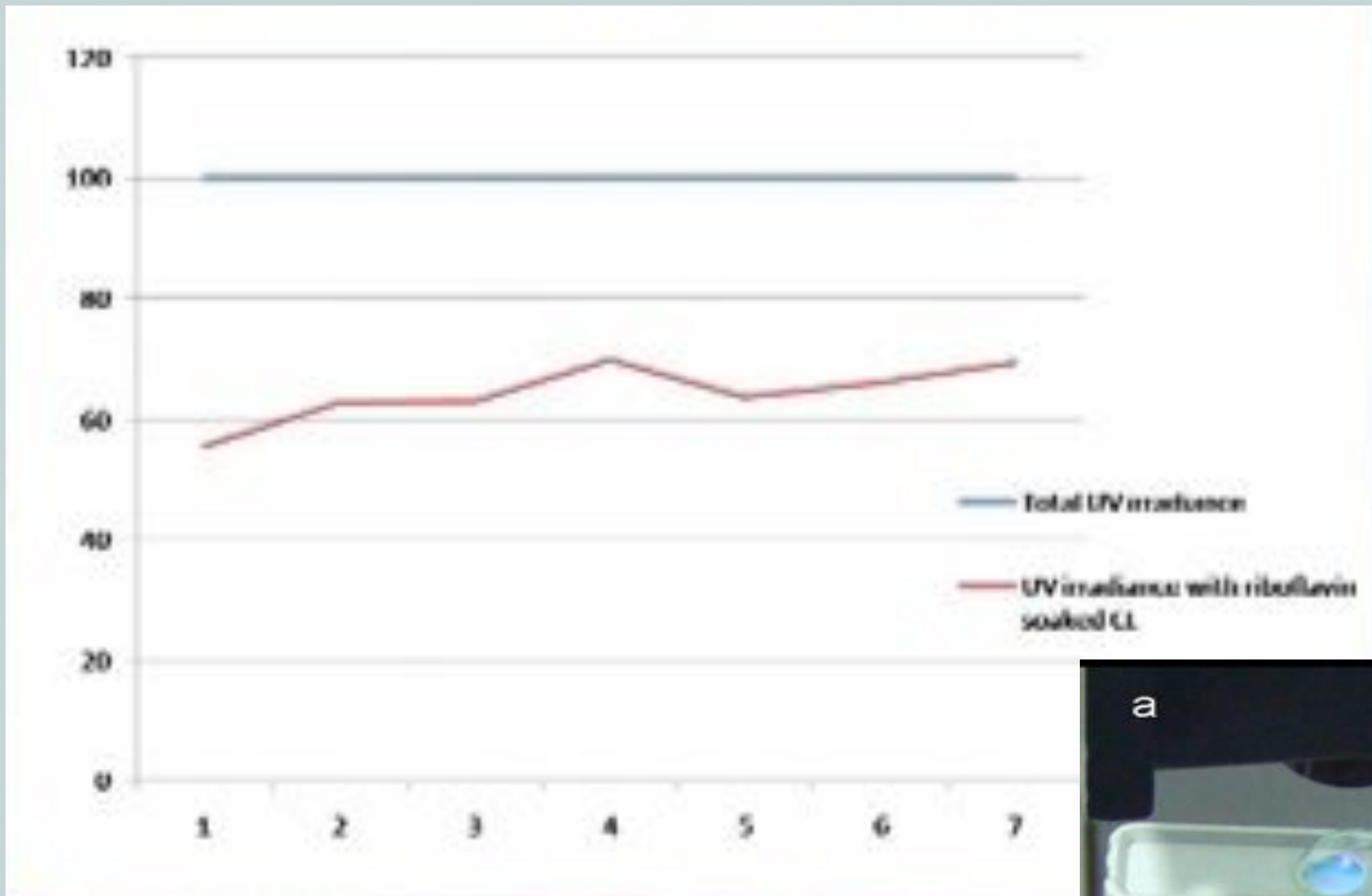
Which Contact lens may be used?

- **Absent or negligible UV filter**
- Thin lens design
- Center thickness: 0.09mm = 90 microns
- Soft lenses follow shape of cornea
- Hydrophilic

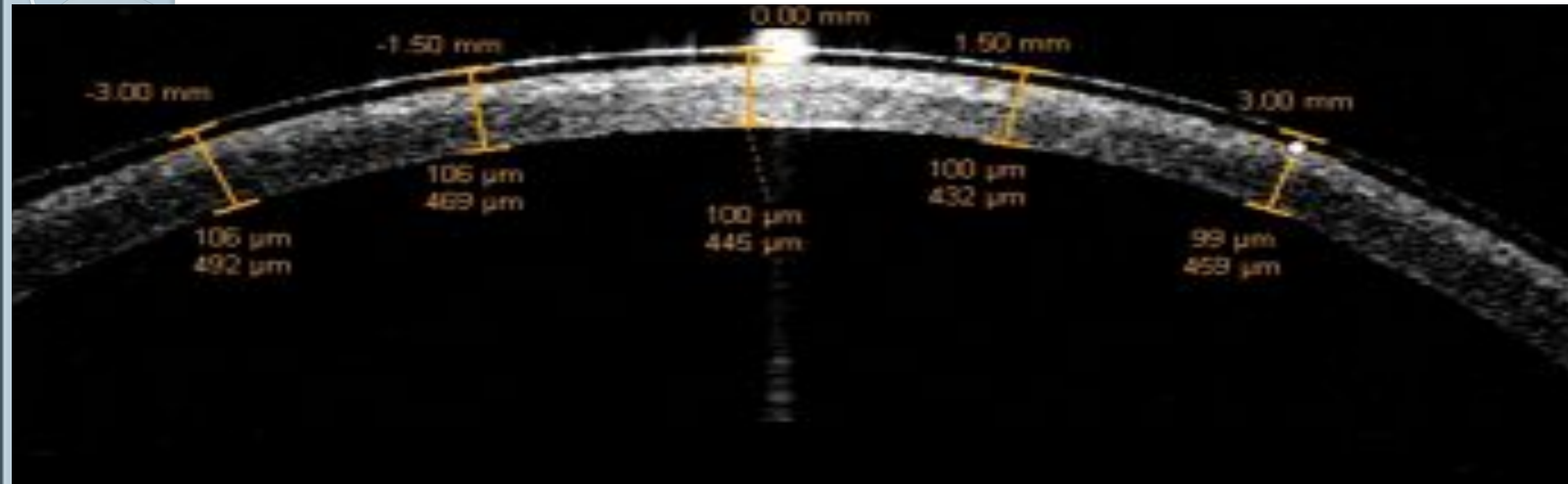
B&L Soflens Daily Disposable (made of Hilafilcon B)



60-70% UV TRANSMISSION THROUGH RIBOFLAVIN SOAKED CL



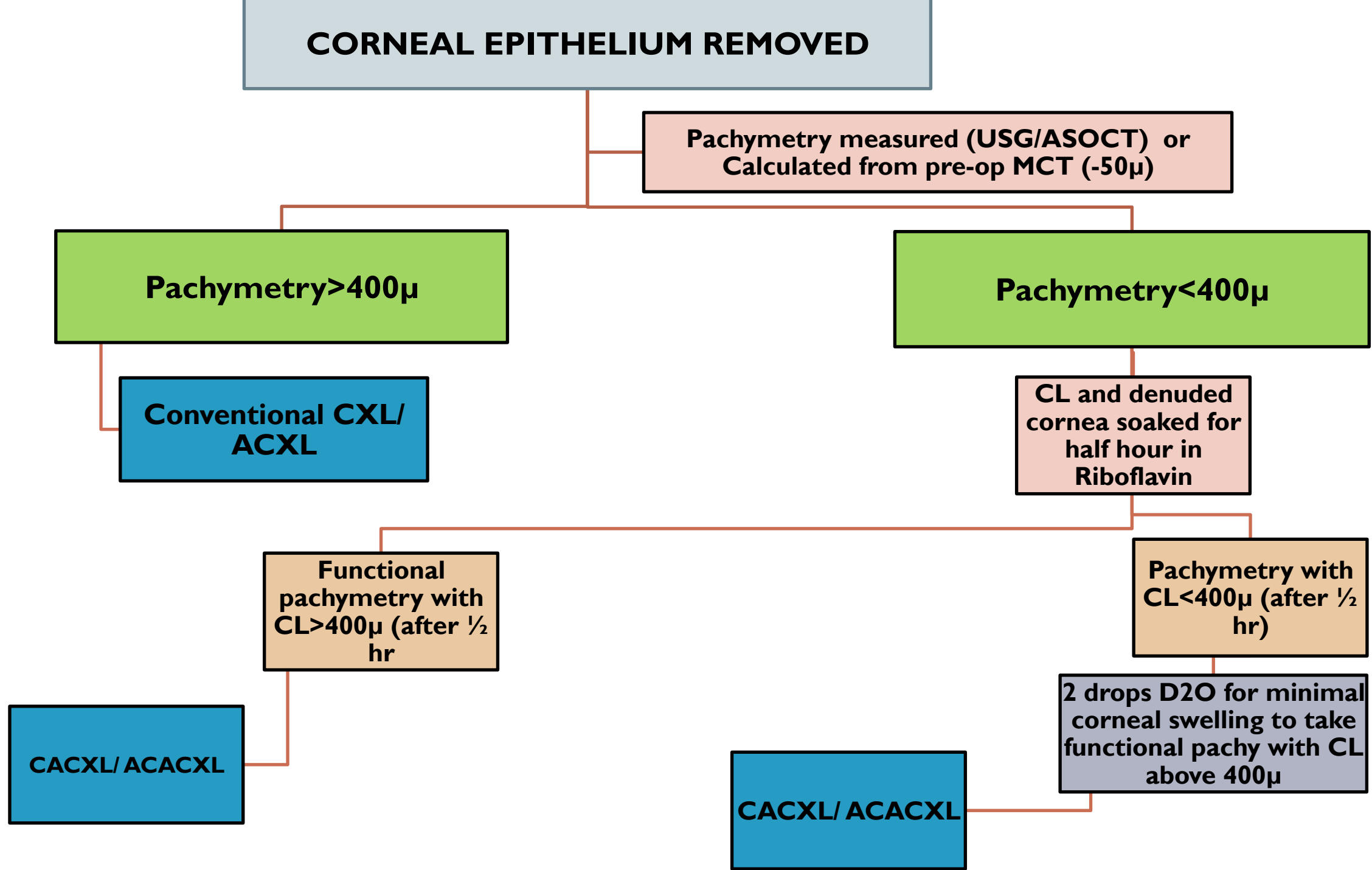
CACXL: INTRA-OPERATIVE ASOCT



Additional average $107.9 \pm 9.4 \mu$ (range 90-124 μ) additional thickness was got

Hence corneas thinner than 400 microns can be treated without need for artificial hydration of the cornea using hypotonic solution

(Jacob S et al. Contact lens-assisted collagen cross-linking (CACXL): A new technique for cross-linking thin corneas. J Refract Surg. 2014 Jun;30(6):366-72)

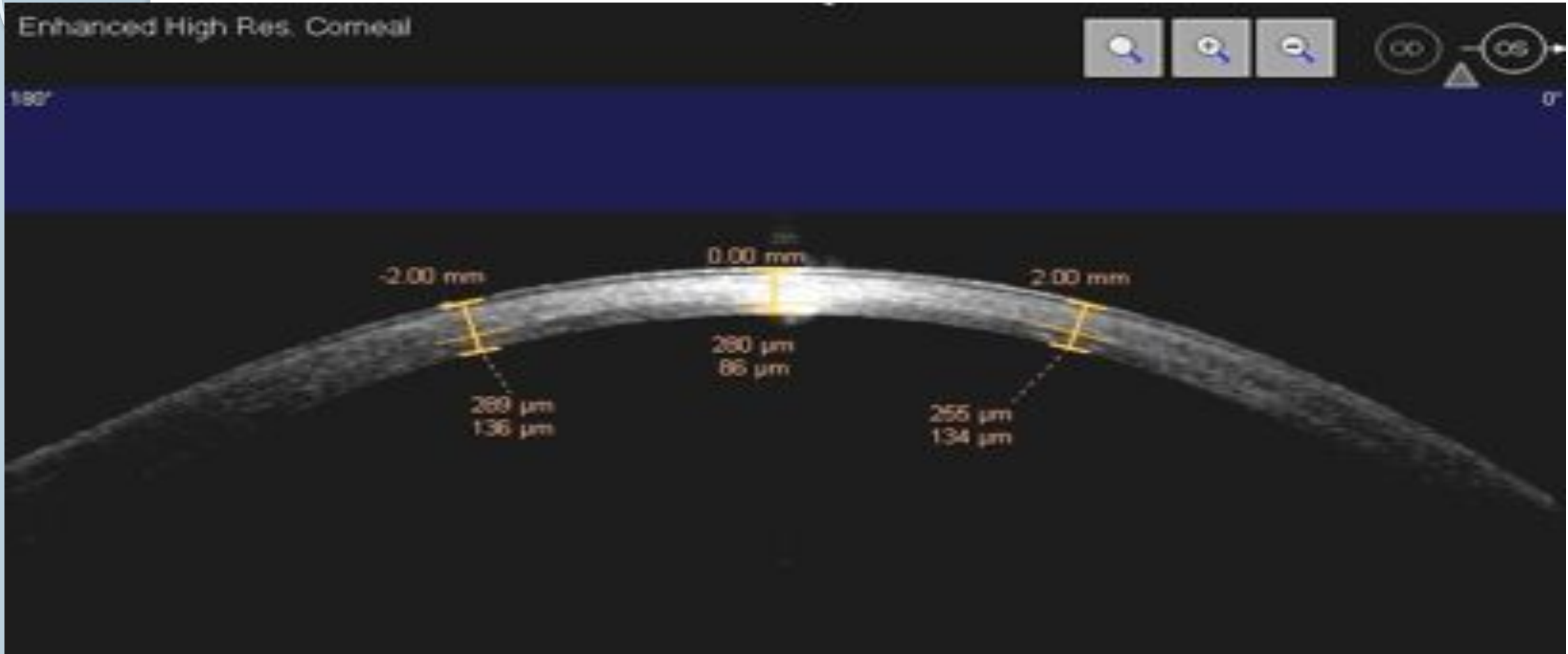


RESULTS

- No decrease in specular count
- At last follow-up: No changes in corneal clarity or other side effects were seen
- No patient showed progression on Orbscan

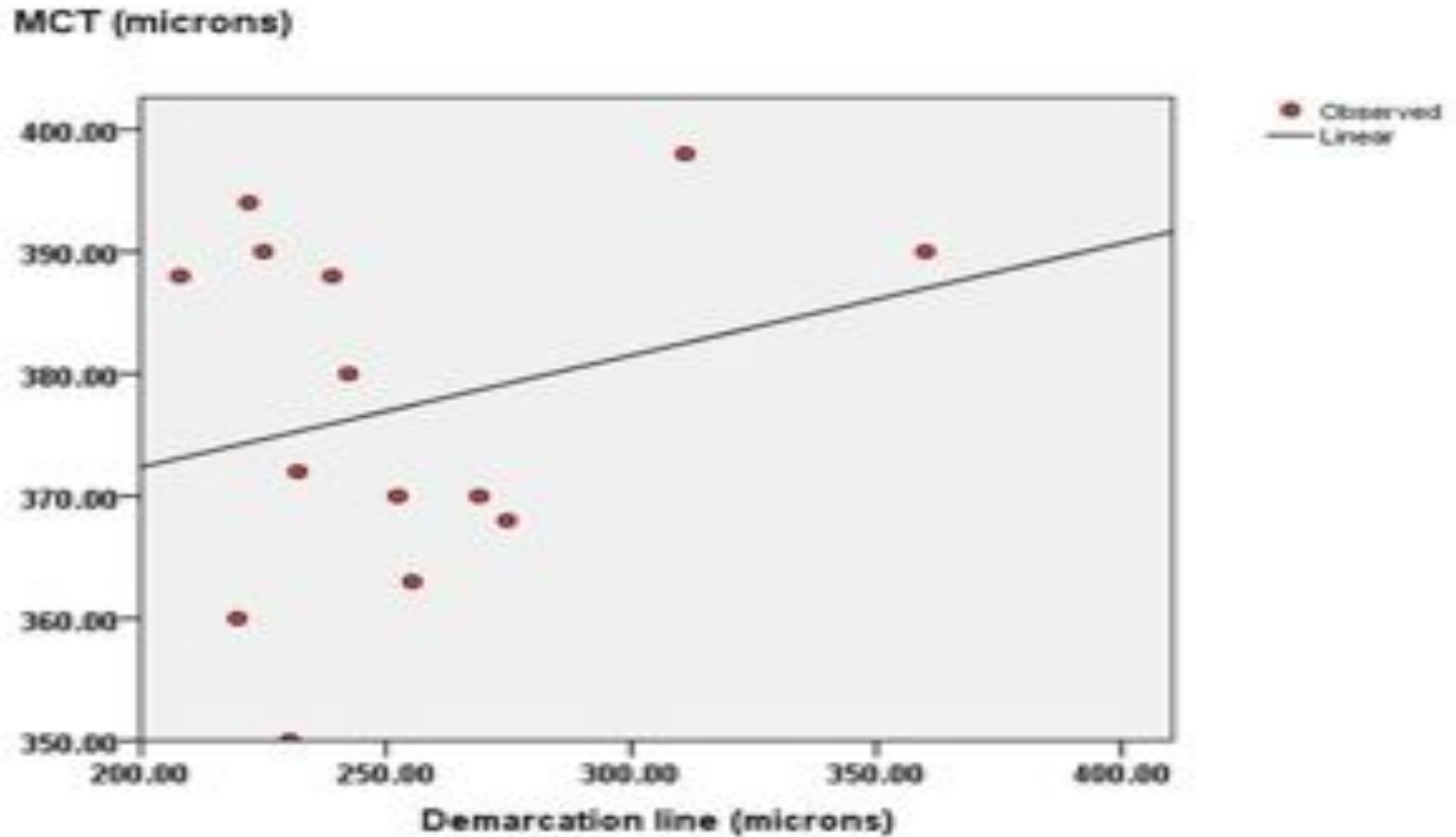


CACXL: DEMARCATION LINE

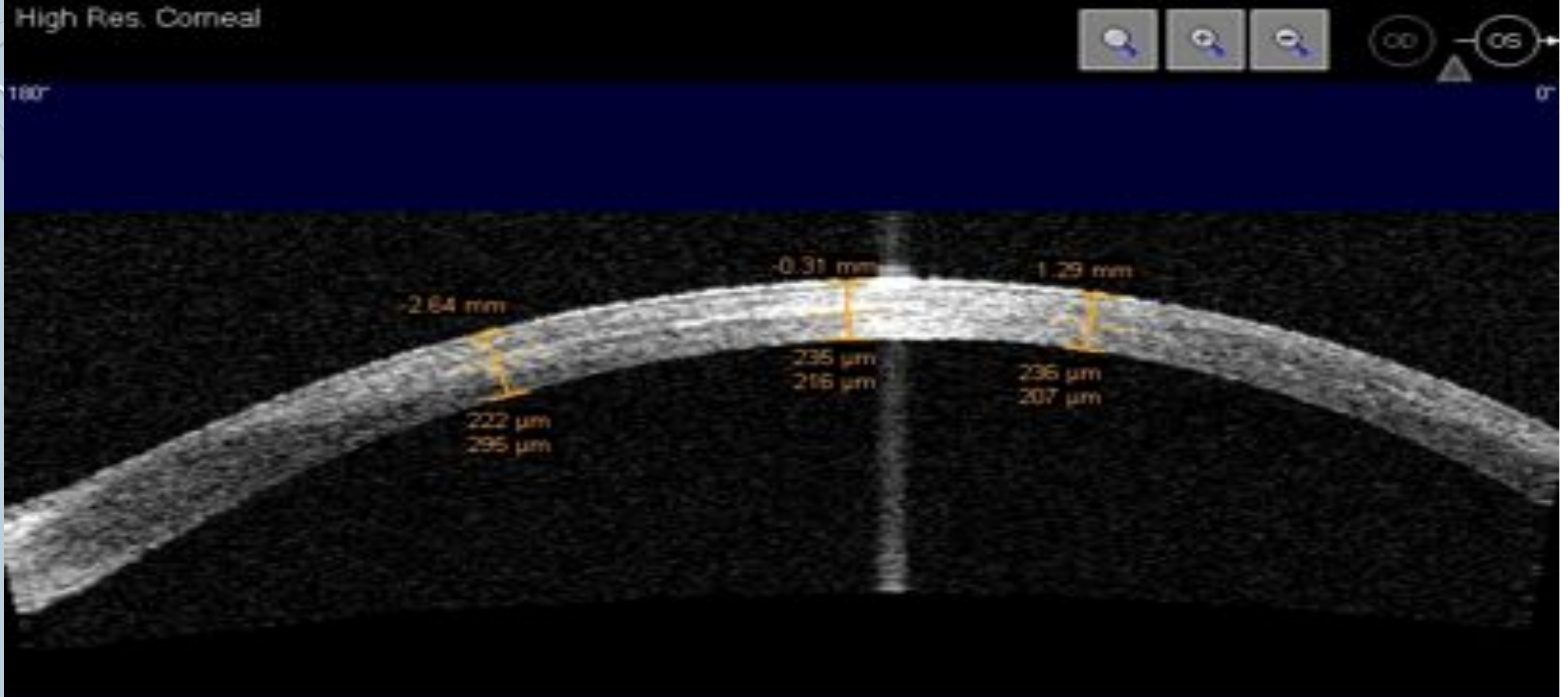


Mean demarcation line: $252.9 \pm 40.8 \mu$ (range 208-260 μ)

CACXL: DEMARCATION LINE

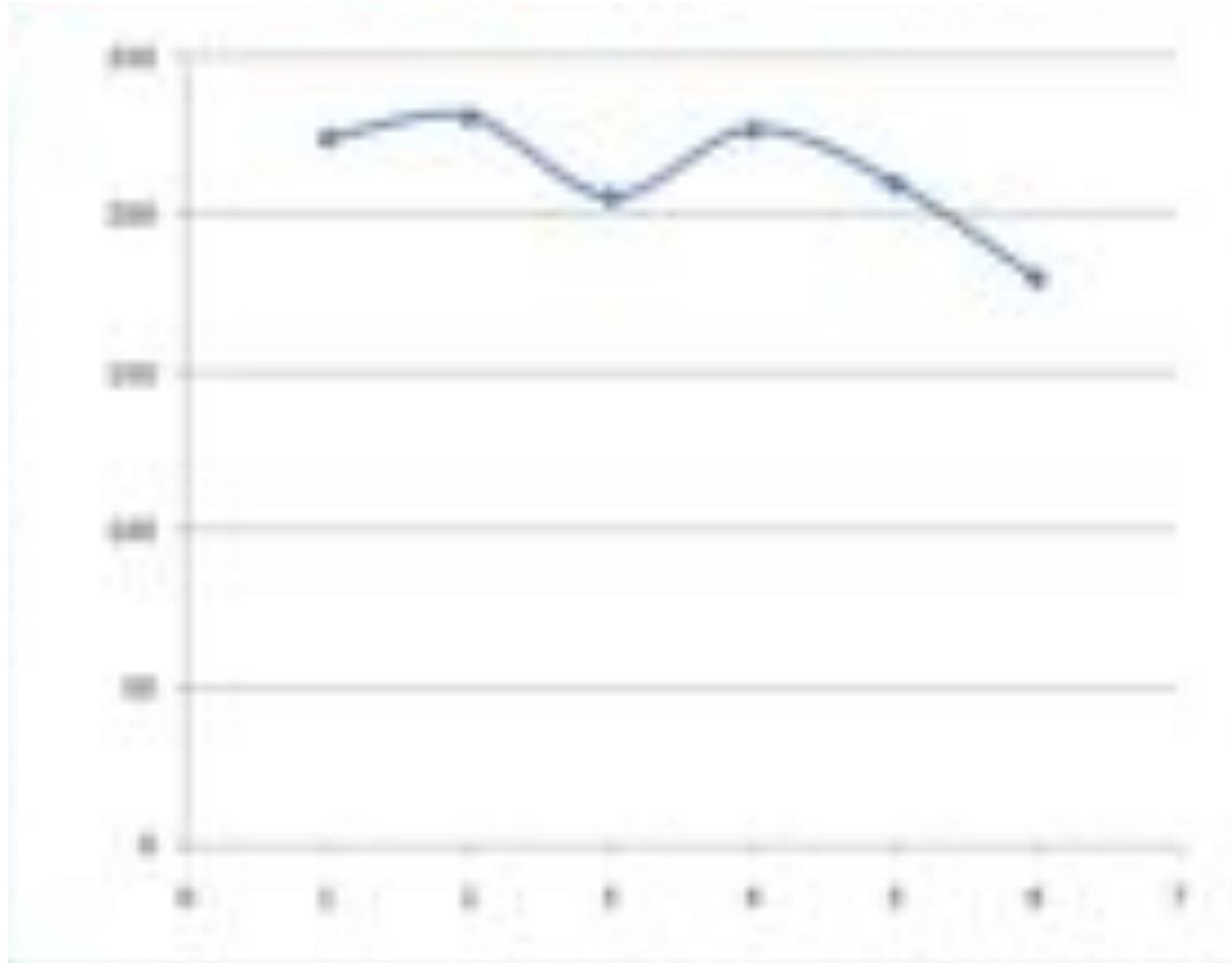


Accelerated CACXL (ACACXL): DEMARCATION LINE



ACACXL Protocol used: Power of 10mW/cm² for 9 min; Energy: 5.4J/cm²)

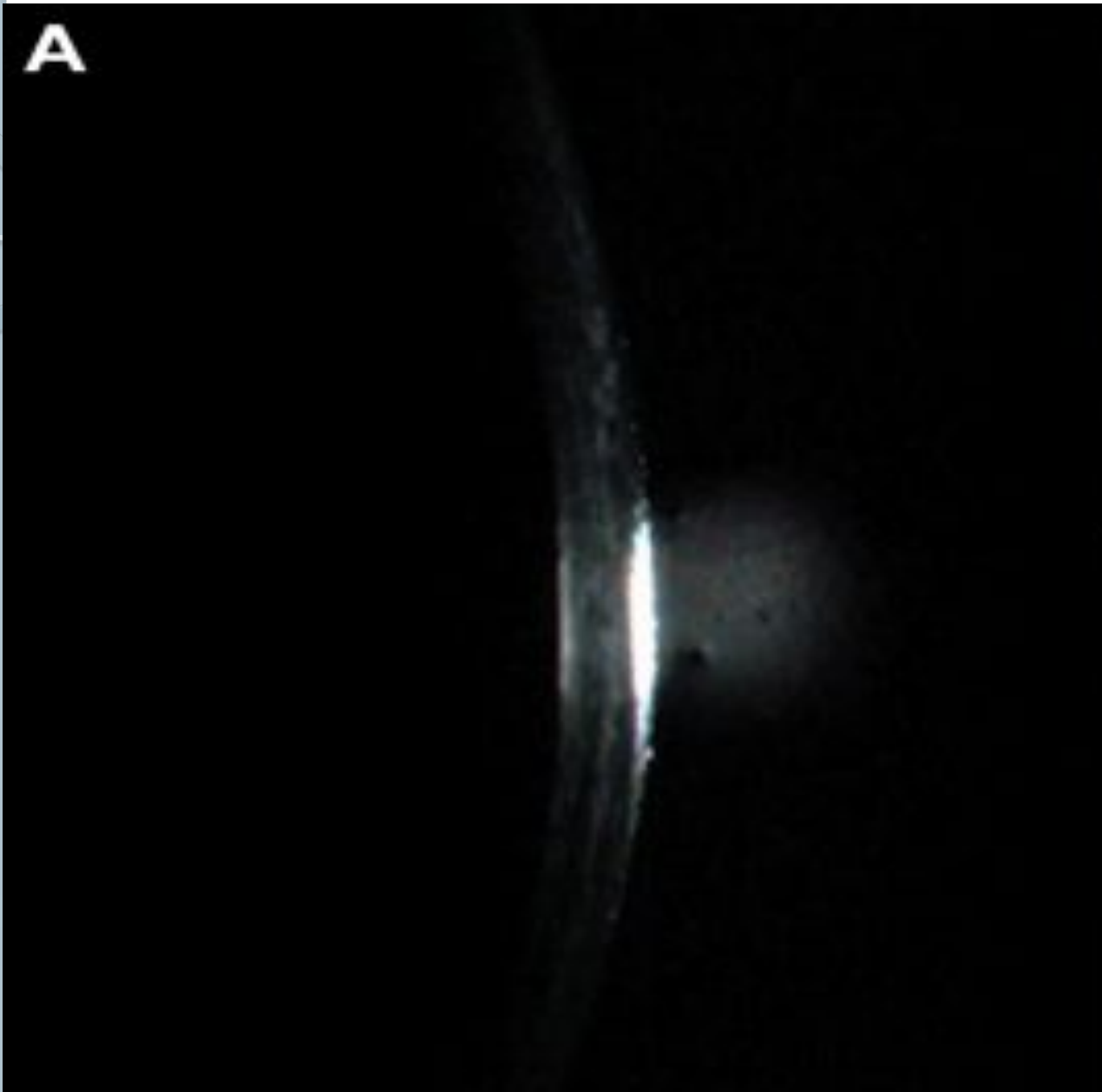
DEMARCATIION LINE (ACACXL)



(n=6)



A



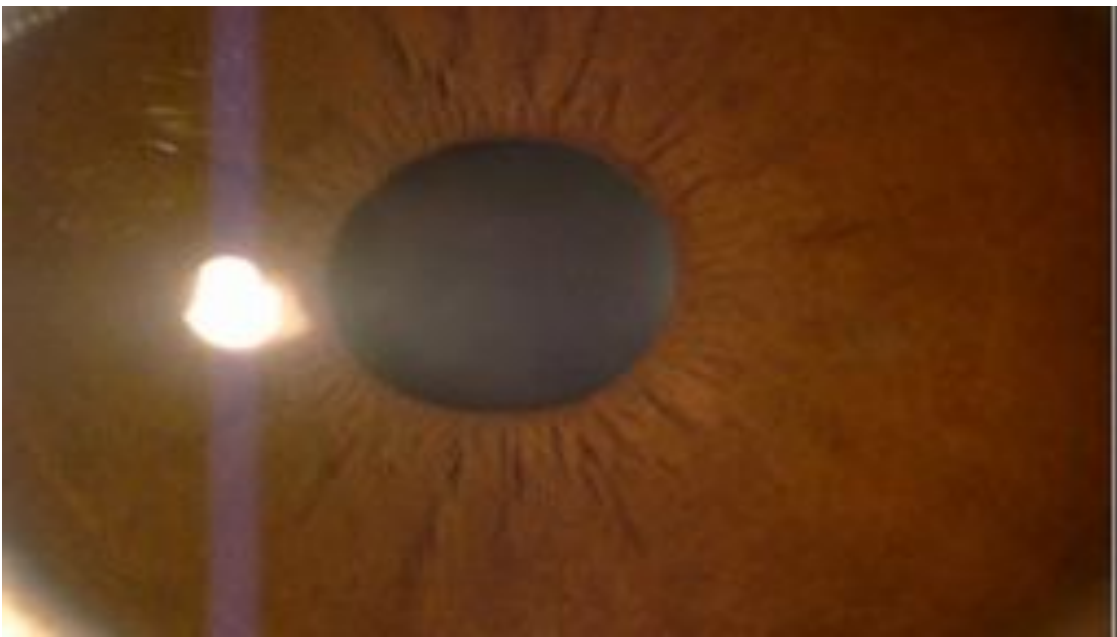
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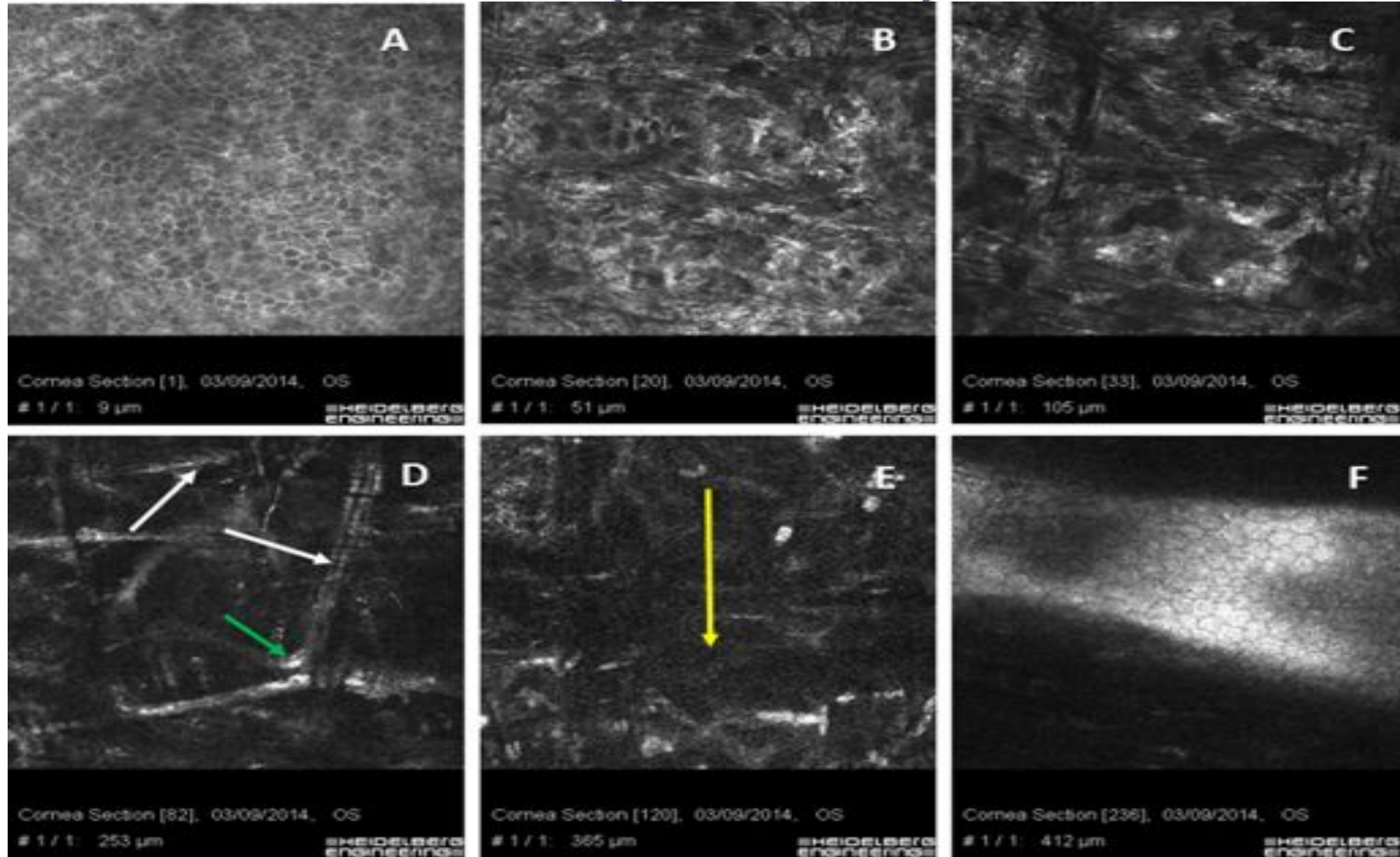
C



ACCACXL

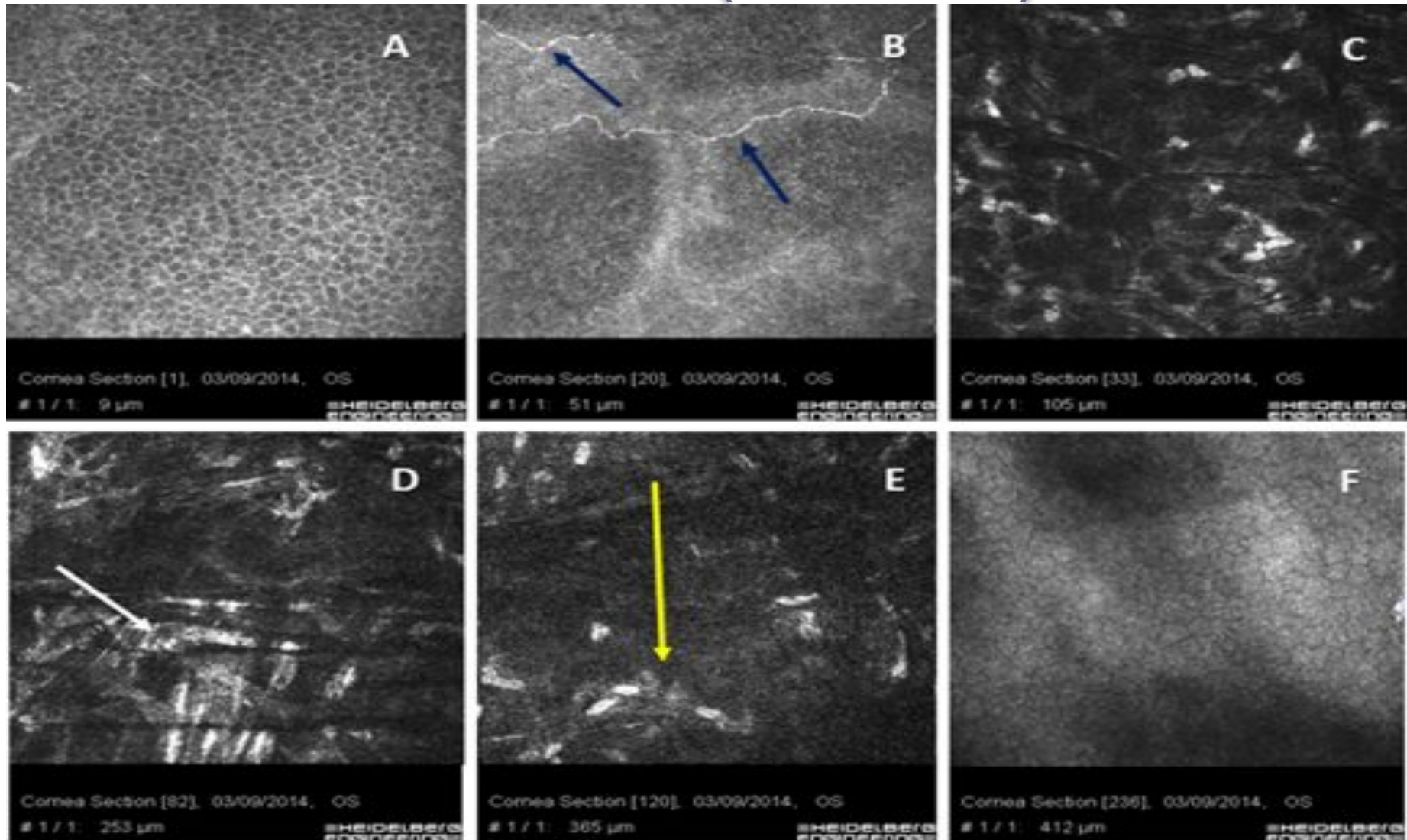


IVCM 1 MONTH (CACXL)



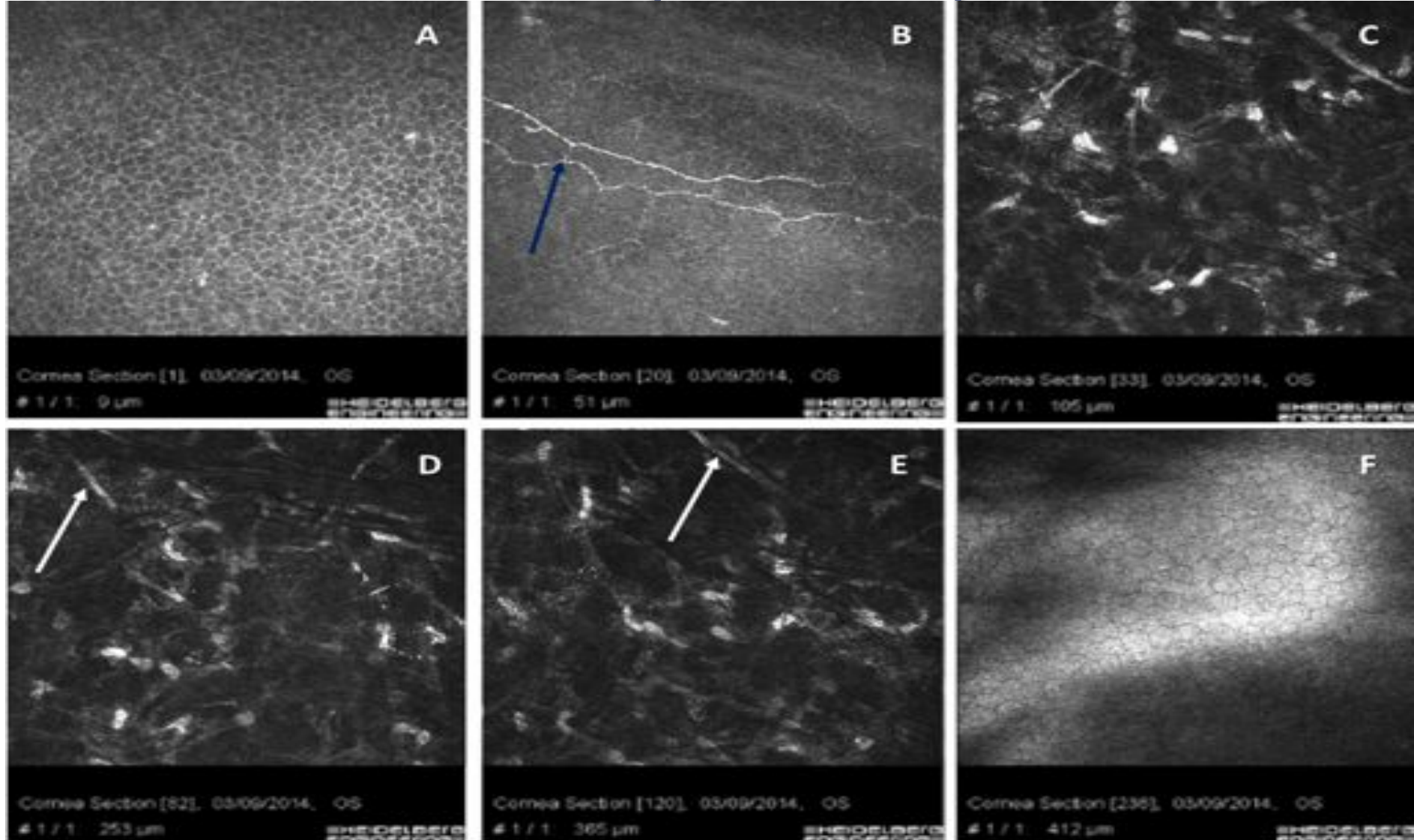
Courtesy, Cosimo Mazzotta, MD; Siena Cross Linking Center;
Siena, Italy

IVCM 3 MONTHS (CACXL)



Courtesy, Cosimo Mazzotta, MD; Siena Cross Linking Center;
Siena, Italy

IVCM 6 MONTHS (CACXL)



Courtesy, Cosimo Mazzotta, MD; Siena Cross Linking Center;
Siena, Italy

ADVANTAGES OF CACXL VS. HYPOOSMOLAR CXL

- Increased spacing of collagen fibrils avoided secondary to artificial hydration. Better cross-links
- Additional time not required for large amounts of corneal swelling
- Hypotonicity of cornea causing potential diffusion of aqueous leading to dilution of Riboflavin concentration.
- Hypotonicity per se may be toxic to endothelium
- Pre-corneal riboflavin film not of sufficient thickness



ADVANTAGES OF CACXL VS. EPI-ON TECHNIQUES

- Disadvantage of epi-on technique:
 - Baiocchi et al* showed that stromal concentration of riboflavin reached safe and effective levels only with epi-off.
 - Post-operative pain and haze are generally bearable with epi-off

- Disadvantages of epi-on avoided:
 - Decreased Riboflavin penetration
 - UV absorption by epithelium

* Baiocchi S, Mazzotta C, Cerretani D, Caporossi T, Caporossi A. Corneal cross-linking: riboflavin concentration in corneal stroma exposed with and without epithelium. *J Cataract Refract Surg.* 2009;35:893-899.

ADVANTAGES OF CACXL VS. SMILE LENTICULE ASSISTED CXL (Sachdev et al; very recently described in 2015)

- Dependent on human donor tissue
- Limited access to donor SMILE lenticule
- Need for donor SMILE lenticule of sufficient thickness (8D)
- Storage of tissue
- Variability of tissue pachymetry depending on storage medium used



ADVANTAGES OF CACXL VS. SMILE LENTICULE ASSISTED CXL (Sachdev et al; very recently described in 2015)

- Edema/ dehydration of lenticule may cause erroneous shifts in pachymetry
- Intra-operative pachymetry (contact)
- Intra-op pachy: Sitting position with standard ASOCT pachymetry may lead to increased risk of lenticule drop
- Need for screening for HIV/ HBsAg/HCV prior to use



ACCELERATED CACXL - ADVANTAGES

- Advantage over Dresden protocol: Intra-operative dehydration less. Significant in these already thin corneas
- HPMC based Riboflavin solutions may be used (Vibex Rapid, Avedro)
- Time taken less for patient and surgeon



PRECAUTIONS

- If functional corneal thickness does not increase to 400μ after placing CL, two drops of distilled water under the CL may be used for the minimal corneal swelling required to take functional pachymetry with CL above 400μ . This avoids large amounts of corneal swelling and attendant disadvantages.
- Any technique of CXL may not be effective in corneas of extreme thinness as sufficient stroma will not be cross-linked to prevent progression.
- In extremely thin or very steep corneas, deep anterior lamellar keratoplasty is preferred





THANK YOU