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# Secondary IOL with Optic Capture


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PEDIATRIC OPHTHALMOLOGY & STRABISMUS

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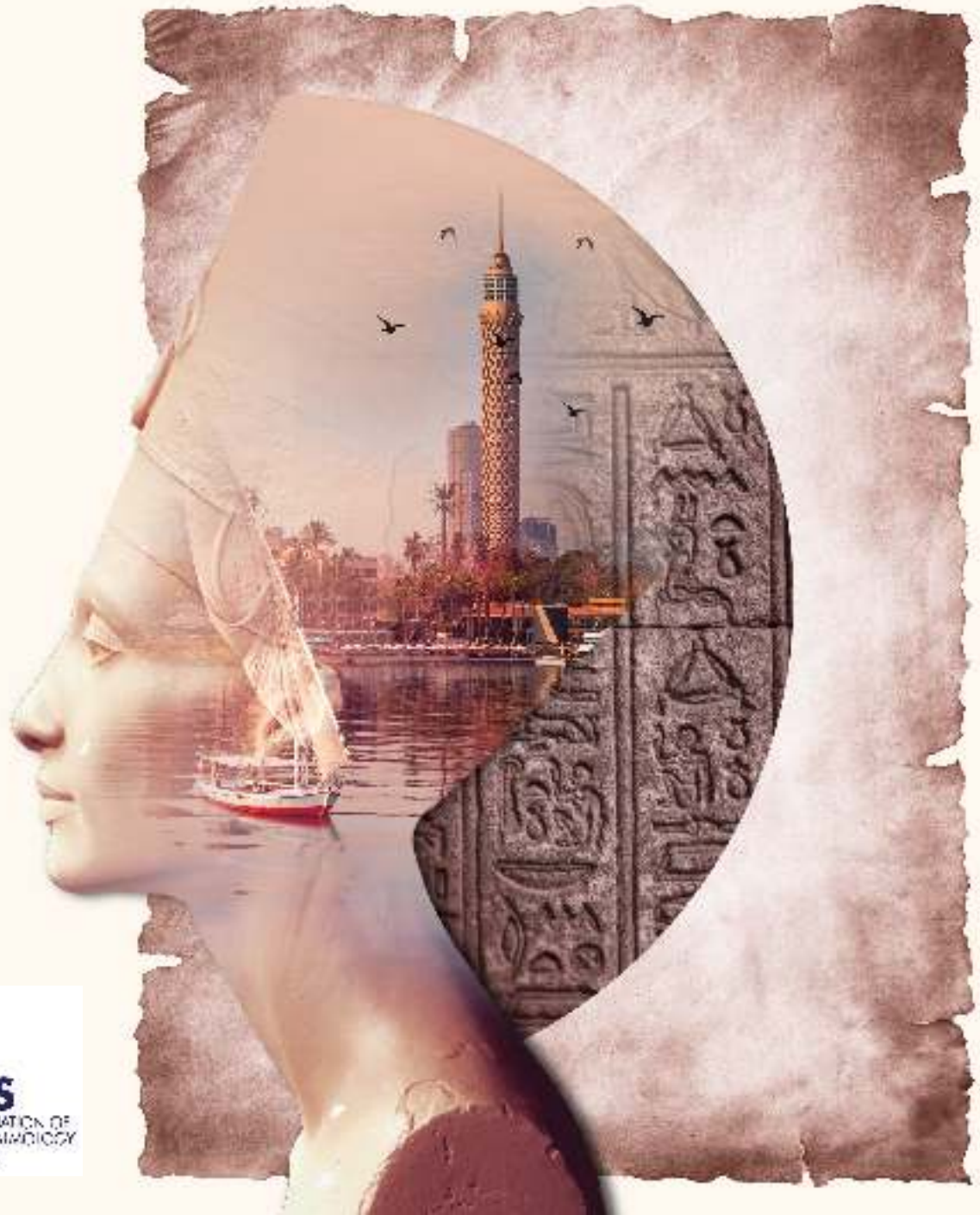


# Introduction

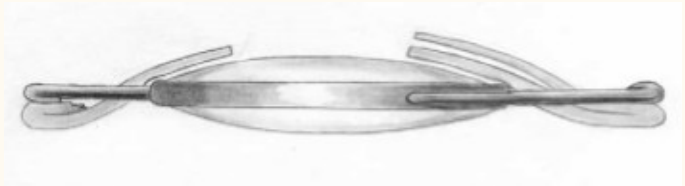
- In secondary IOL implantation, **fibrous fusion of the anterior and posterior capsular leaflets** makes them inseparable and the *ideal in-the-bag* option is usually unachievable.

- Consequently, opting for IOL placement in the **ciliary sulcus** is often the most practical alternative available.

# Optic capture technique background

- The concept of placing the haptics in the **sulcus** and then capturing the optic through the **anterior CCC opening** was first described by **Neuhann.**

- **Gimbel and DeBroff** desribed the technique with the haptics in the **ciliary sulcus** and the optic through a **posterior CCC opening**.



*Gimbel HV, DeBroff BM., 2004*

- However, the optic capture techniques have been mainly employed and studied in
  - ✓ **Primary pediatric or**
  - ✓ **Adult cataract surgery**.

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***Neuhann T (1991)*** *The American Society of Cataract and Refractive Surgery Symposium on Cataract, IOL and Refractive Surgery*

***Gimbel HV, DeBroff BM****. Intraocular lens optic capture. J Cataract Refract Surg. 2004;30(1):200–6*

# Intraocular lens (IOL) tilt and decentration after secondary IOL sulcus implantation versus optic capture in pediatric aphakia


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# Aim of study

- We compared the **ACD, tilt and decentration** in secondary IOL implantation in the sulcus versus IOL implantation in the sulcus with optic capture for pediatric aphakia using ultrasound biomicroscopy (UBM).

# Patients and methods:

- **Prospective**, comparative, institutional study
- **44 eyes of 25 aphakic children** ( 1-3 years)  scheduled for
- **secondary IOL implantation** between November 2021 and June 2023

# Patient population

- Sufficient capsular support with the capsular opening size not exceeding 5.0 mm

- **Exclusion criteria:** Traumatic cataracts, insufficient capsular support, microphthalmia or microcornea

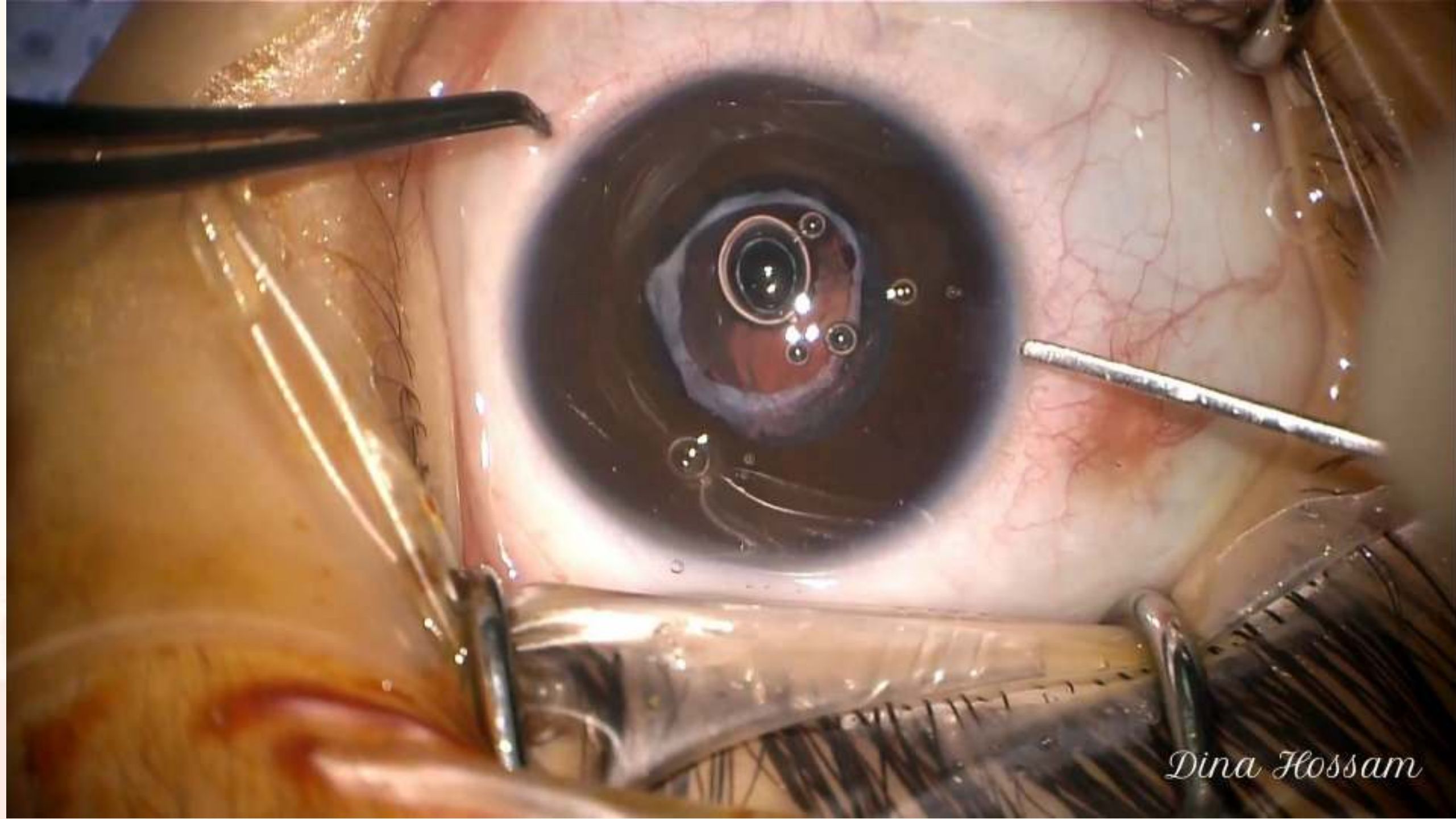
# The eyes were randomized into two groups:

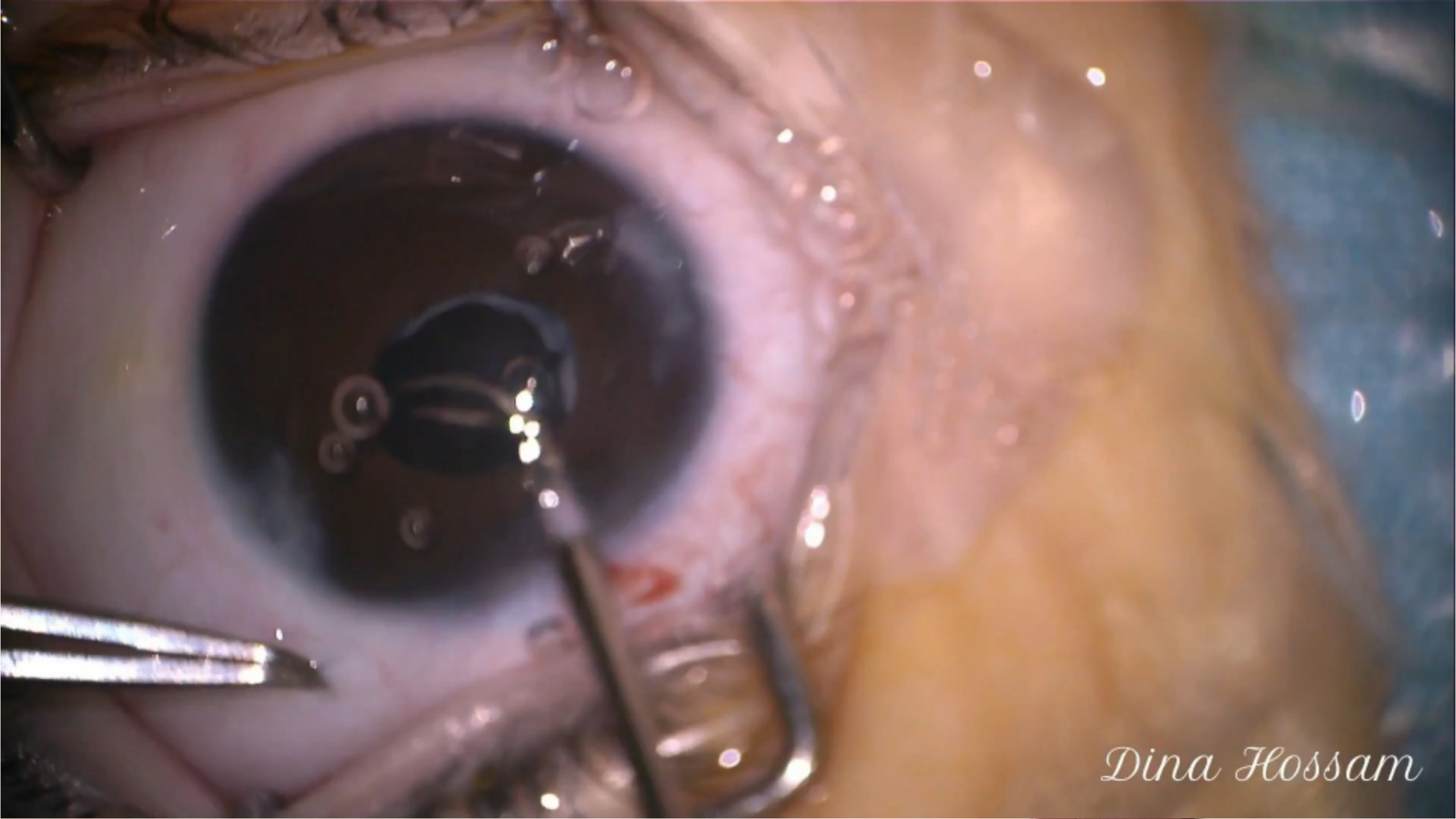
- **Group A (sulcus group):** 22 eyes that underwent implantation of a multipiece hydrophobic acrylic IOL in the ciliary sulcus

- **Group B (capture group):** 22 eyes optic capture of the same type of IOL after modifying the size of the capsular opening using either

✓ 23G vitrector

✓ micro-scissors


Dina Hossam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# UBM

- UBM examinations were conducted for all patients at **3 and 6 months**
- **The ACD** was measured from the central inner corneal surface to the anterior surface of the IOL
- **The angles in the four quadrants** were measured using the angle measurement tool provided by the software of the UBM device

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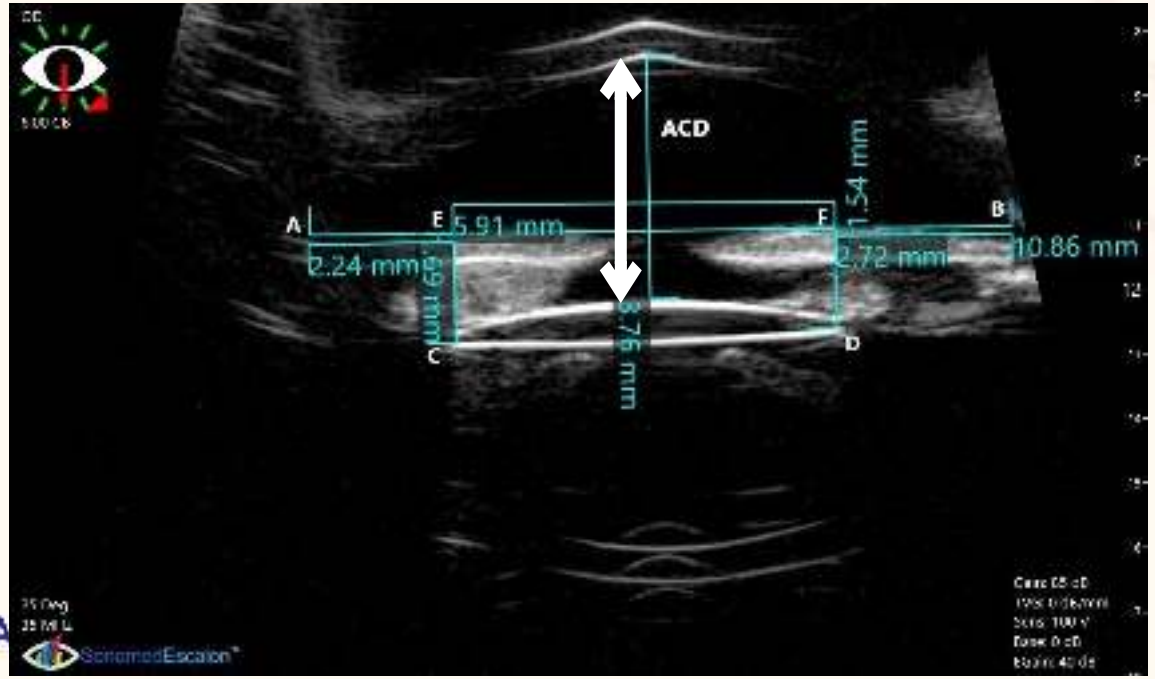
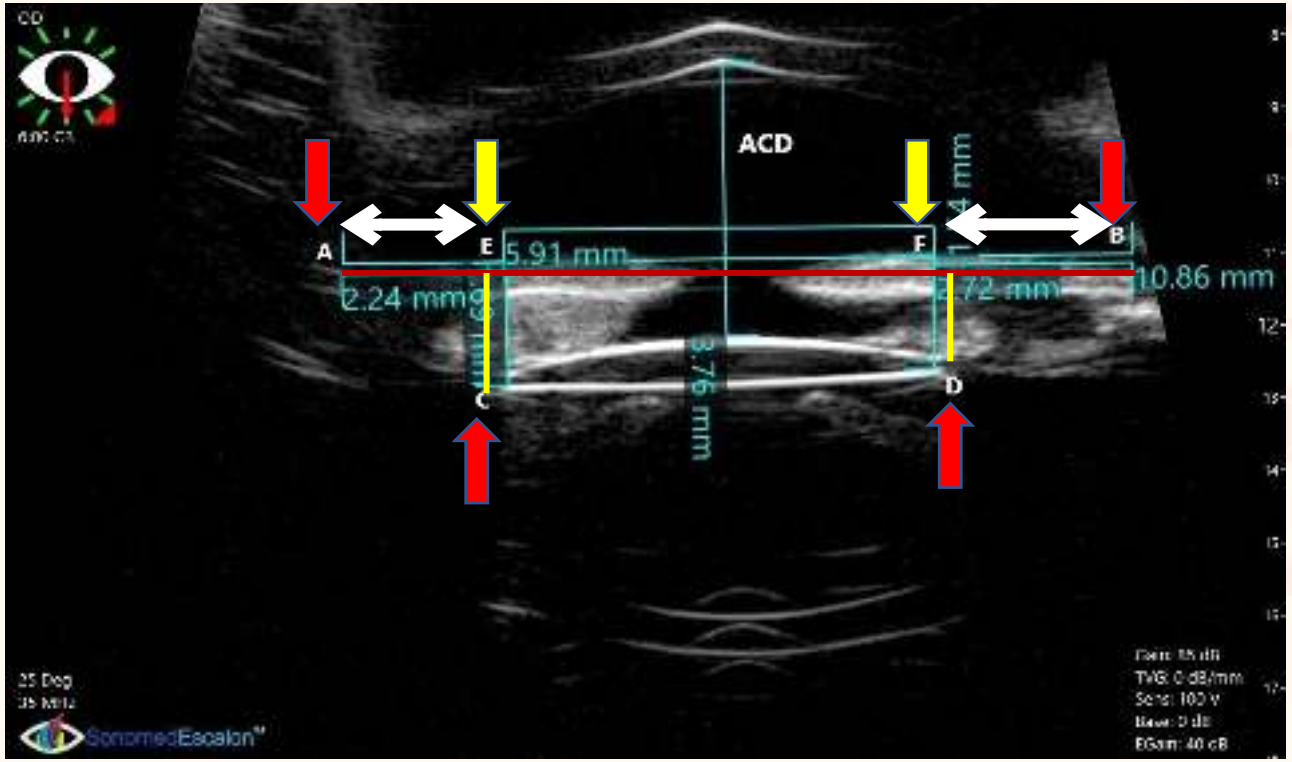


**The decentration** of the IOL was calculated as half the difference between the distances AE and FB, expressed as (|AE—FB|)

**The tilt** of the IOL was determined by calculating the angle (θ) using the following formula:

$$\theta = \arctan(|CE - DF| EF) \times 180/\pi$$




*Zhao Y-e, et al. (2017) Long-term outcomes of ciliary sulcus versus capsular bag fixation of intraocular lenses in children: An ultrasound biomicroscopy study. PLOS ONE*

# Results

- **Mean age:** 22.3 months (12-30)
- **Demographic data:** No difference between both groups

| | | Sulcus | Capture | Test-value | P-value | Sig. |
|---|---|---|---|---|---|---|
| | | No.=22 | No.=22 | | | |
| Age in years | Mean±SD<br>Range | 1.86 ± 0.46<br>1 – 2.5 | 1.65 ± 0.33<br>1 – 2.1 | 1.806• | 0.078 | NS |
| Sex | Female<br>Male | 15 (68.2%)<br>7 (31.8%) | 12 (54.5%)<br>10 (45.5%) | 0.863* | 0.353 | NS |
| Laterality | OS<br>OD | 9 (40.9%)<br>13 (59.1%) | 12 (54.5%)<br>10 (45.5%) | 0.820* | 0.365 | NS |
| Pre or full term | Full term | 22 (100%) | 22 (100%) | – | – | – |
| Uni/bilateral | Unilateral<br>Bilateral | 2 (9.1%)<br>20 (90.9%) | 4 (18.2%)<br>18 (81.8%) | 0.772* | 0.380 | NS |
| Cataract etiology | Congenital | 22 (100%) | 22 (100%) | – | – | – |
| Family history | Negative<br>Positive | 20 (90.9%)<br>2 (9.1%) | 18 (81.8%)<br>4 (18.2%) | 0.772* | 0.380 | NS |
| Consanguinity | Negative<br>Positive | 21 (95.5%)<br>1 (4.5%) | 17 (77.3%)<br>5 (22.7%) | 3.088* | 0.079 | NS |

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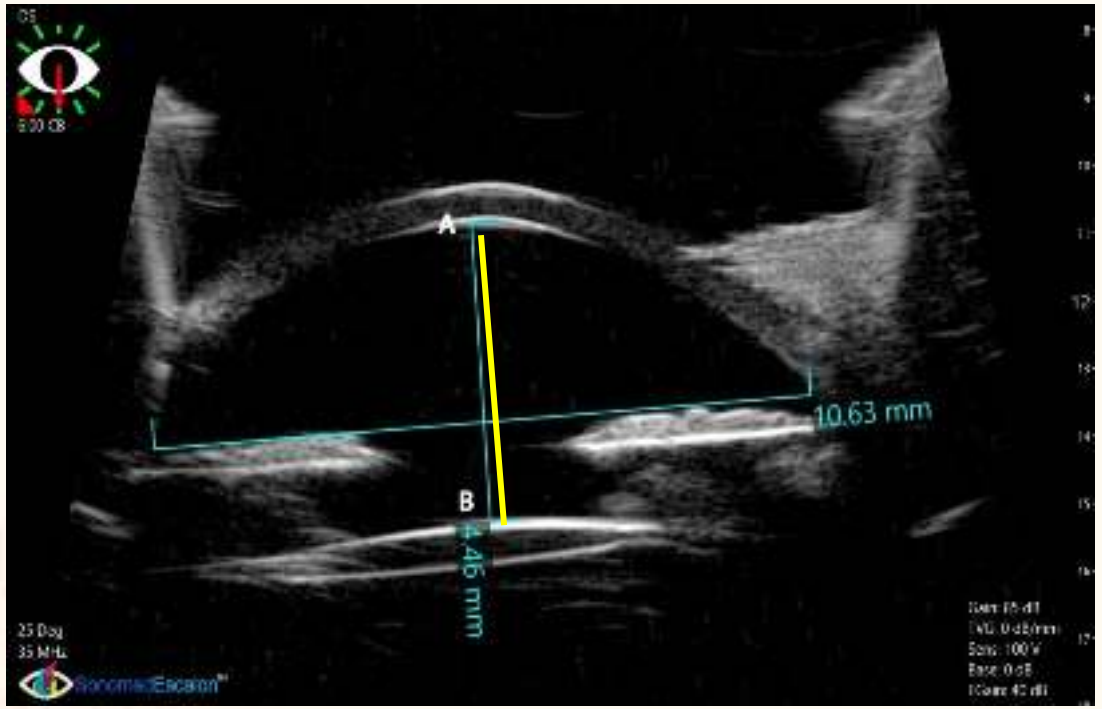
# Results

**Preoperative CCT, ACD, AC angles:** No difference between both groups

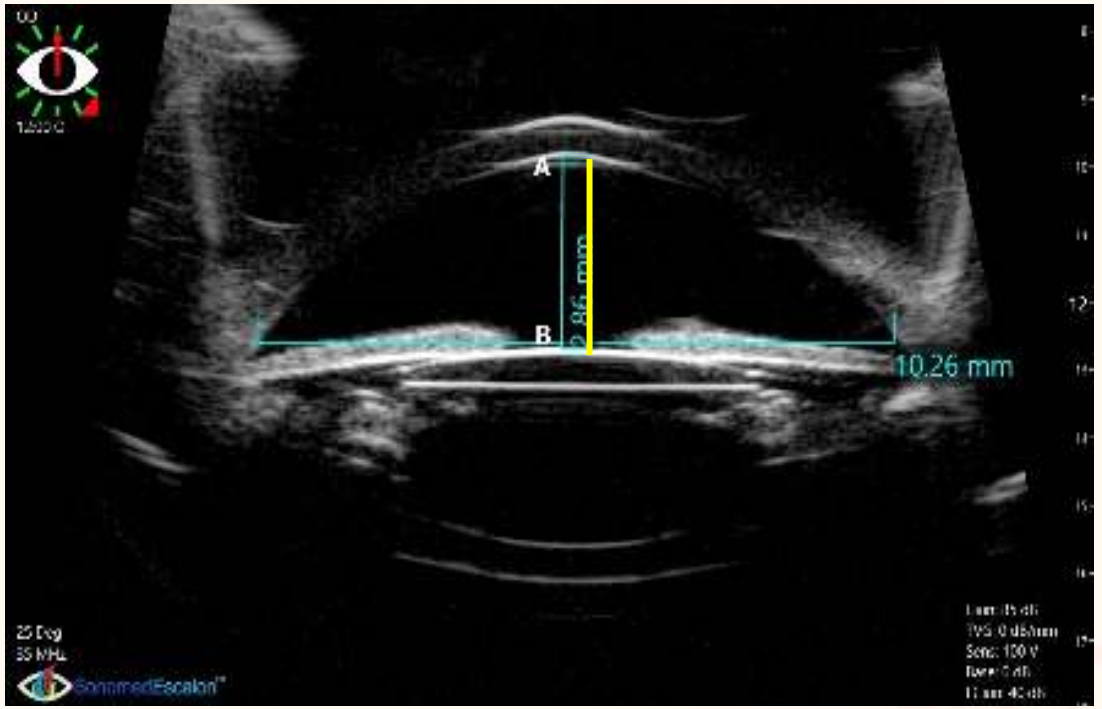
| | | Sulcus | Capture | Test-value | P-value | Sig. |
|---|---|---|---|---|---|---|
| | | No.=22 | No.=22 | | | |
| CCT pre (microns) | Mean±SD | 558.64 ± 23.15 | 561.36 ± 37.07 | -0.293• | 0.771 | NS |
| | Range | 500 – 610 | 460 – 640 | | | |
| ACD pre (mm) | Mean±SD | 2.73 = 0.24 | 2.86 ± 0.39 | -1.252• | 0.218 | NS |
| | Range | 2.28 – 3.06 | 2.1 – 3.58 | | | |
| Superior angle pre (degrees) | Mean±SD | 45.3 – 2.89 | 43.56 + 3.41 | 1.826• | 0.075 | NS |
| | Range | 42 – 53 | 35.5 – 50.09 | | | |
| Inferior angle pre (degrees) | Mean±SD | 44.31 ± 3.43 | 43.64 ± 4.11 | 0.590• | 0.559 | NS |
| | Range | 40 – 50 | 35 – 49 | | | |
| Nasal angle pre (degrees) | Mean±SD | 45.59 ± 3.38 | 43.92 ± 4.05 | 1.483• | 0.146 | NS |
| | Range | 40 – 53.6 | 35.5 – 50 | | | |
| Temporal angle pre (degrees) | Mean±SD | 44.85 ± 2.93 | 44.93 ± 5.17 | -0.061• | 0.952 | NS |
| | Range | 40 – 51.5 | 34.7 – 53 | | | |

# ACD *(6 months)*

**The capture group exhibited a deeper anterior chamber compared to the sulcus group**



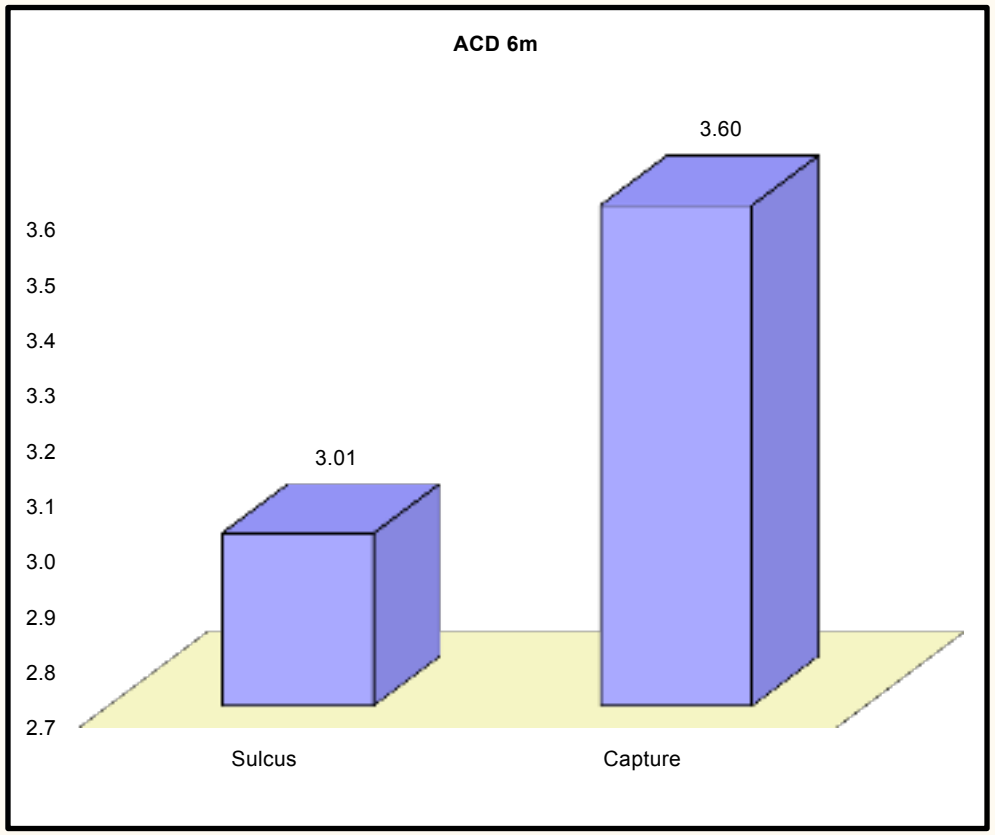

Capture




Sulcus

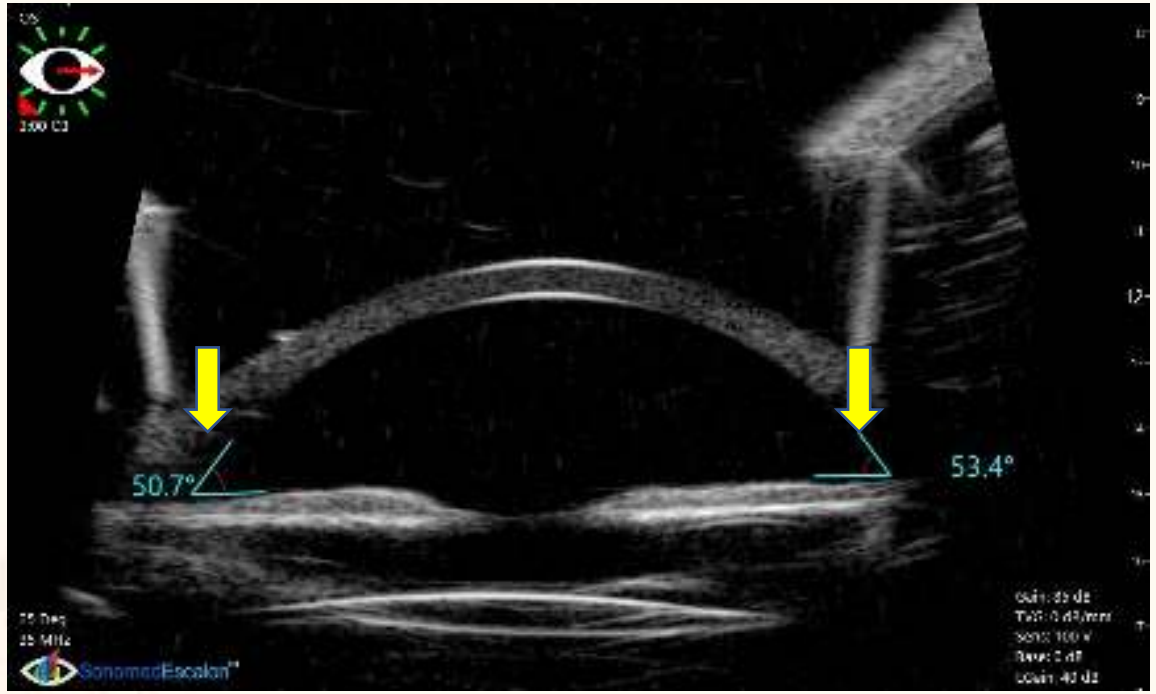
# ACD *(6 months)*

**with a mean difference of ±0.54 mm *(3.01 mm vs 3.6 mm)***

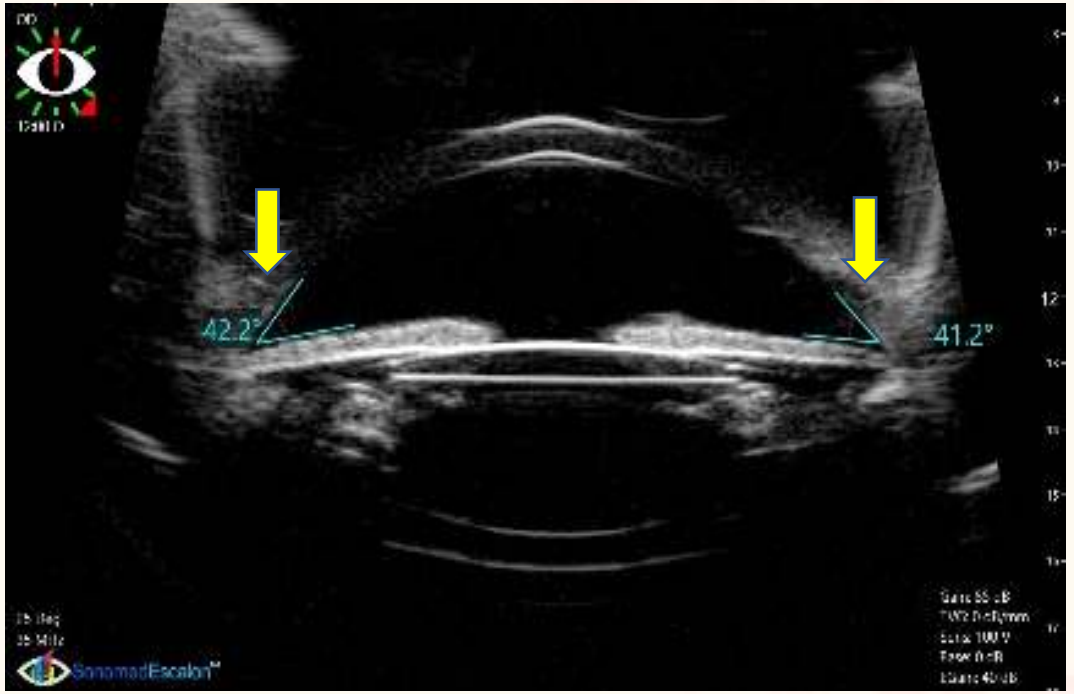


# AC angles *(6 months)*

## were significantly wider in the capture group compared to the sulcus group

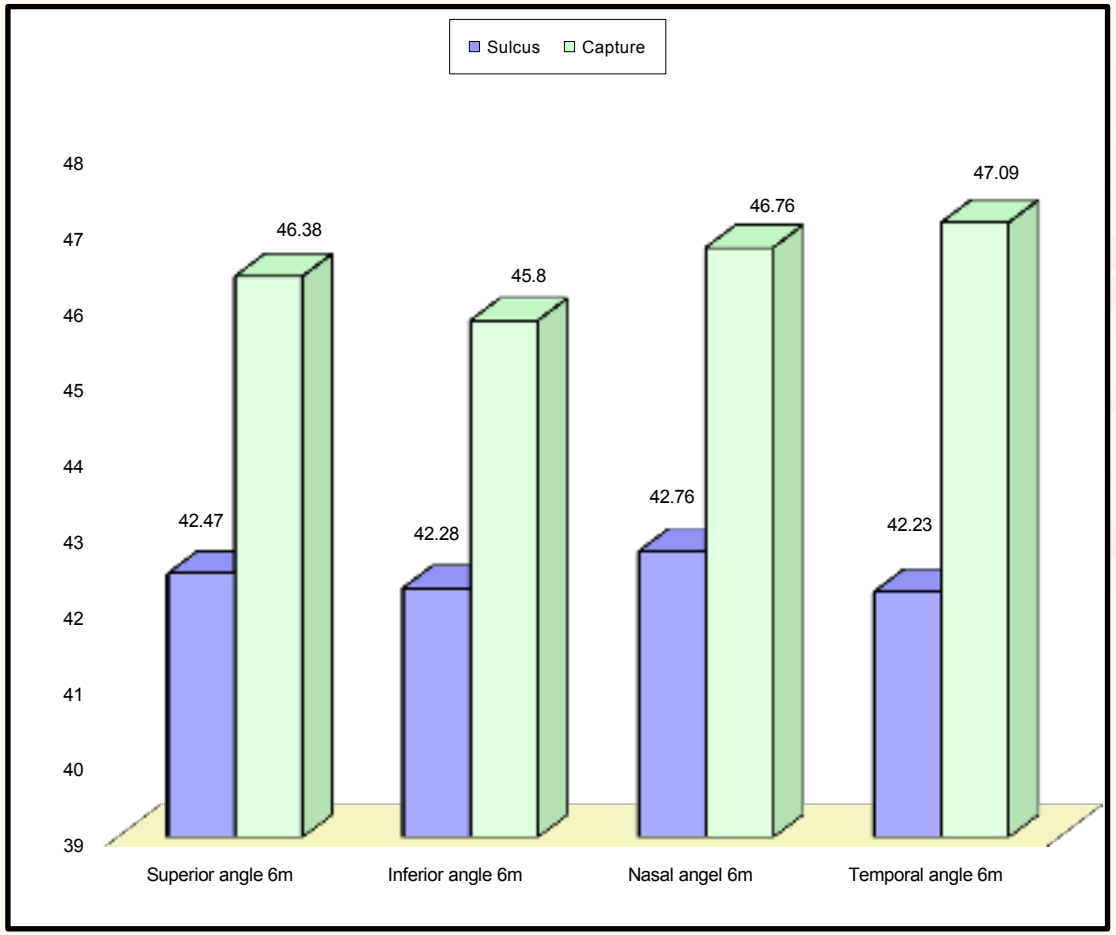



Capture



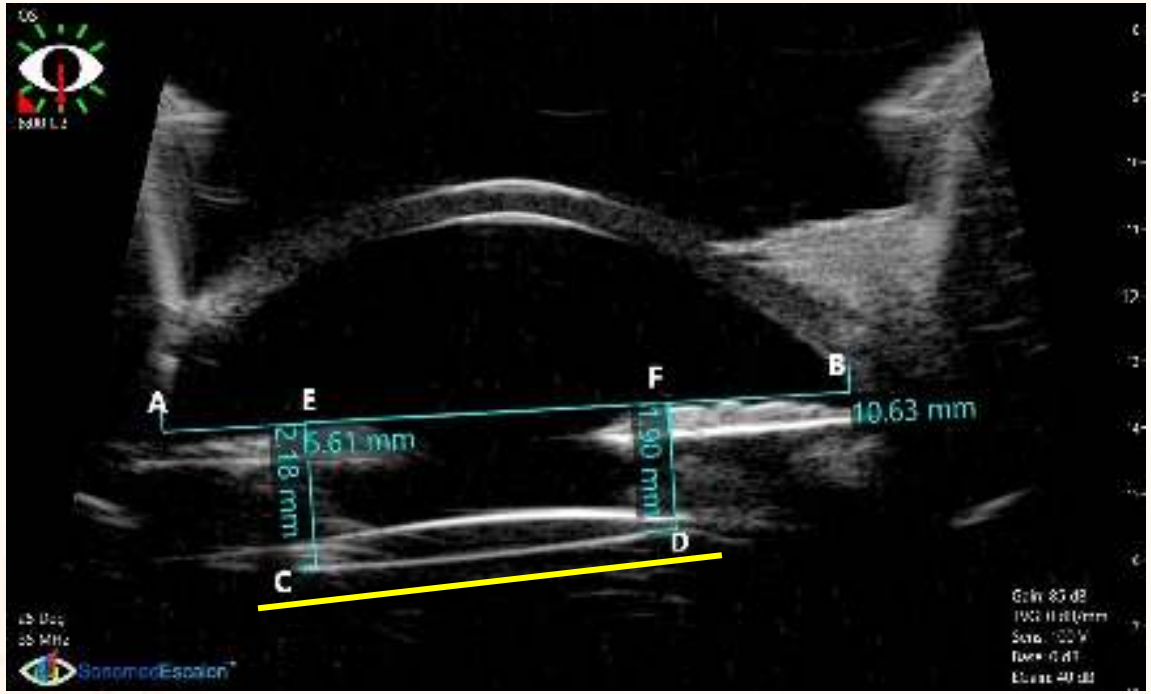

Sulcus

# AC angles in the 4 quadrants were significantly wider in the capture group compared to the sulcus group

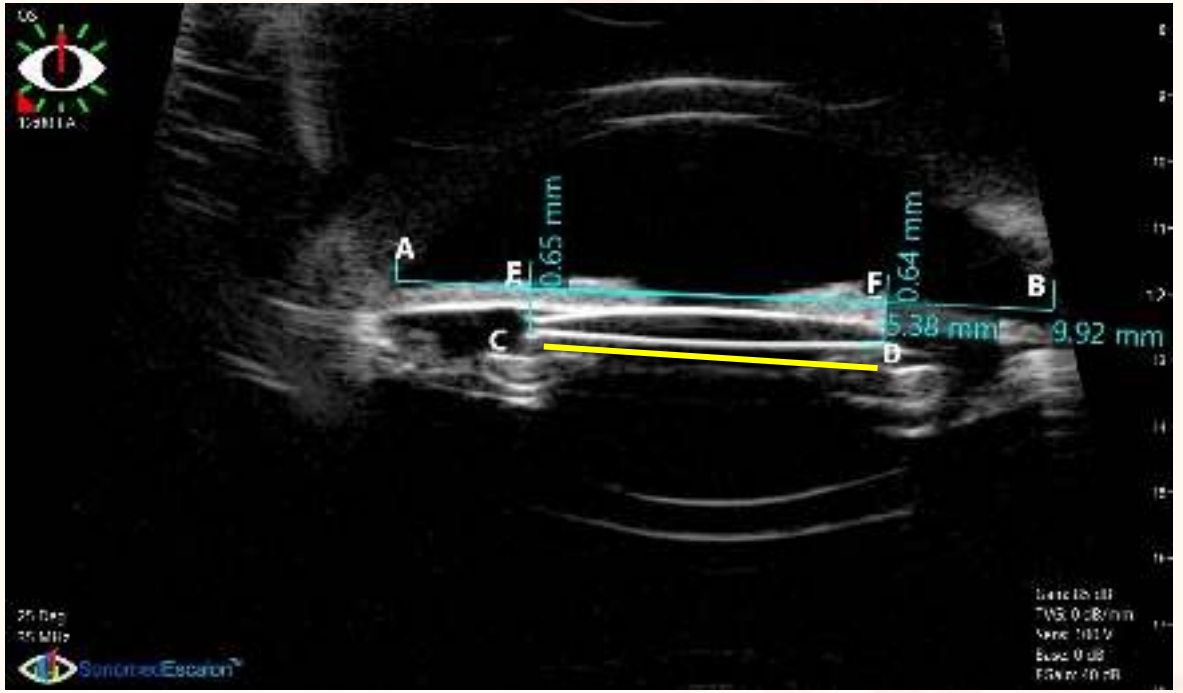


# IOL Tilt ((*6 months*)

**The IOL in the capture group demonstrated a statistically significant higher degree of tilt compared to the sulcus group**



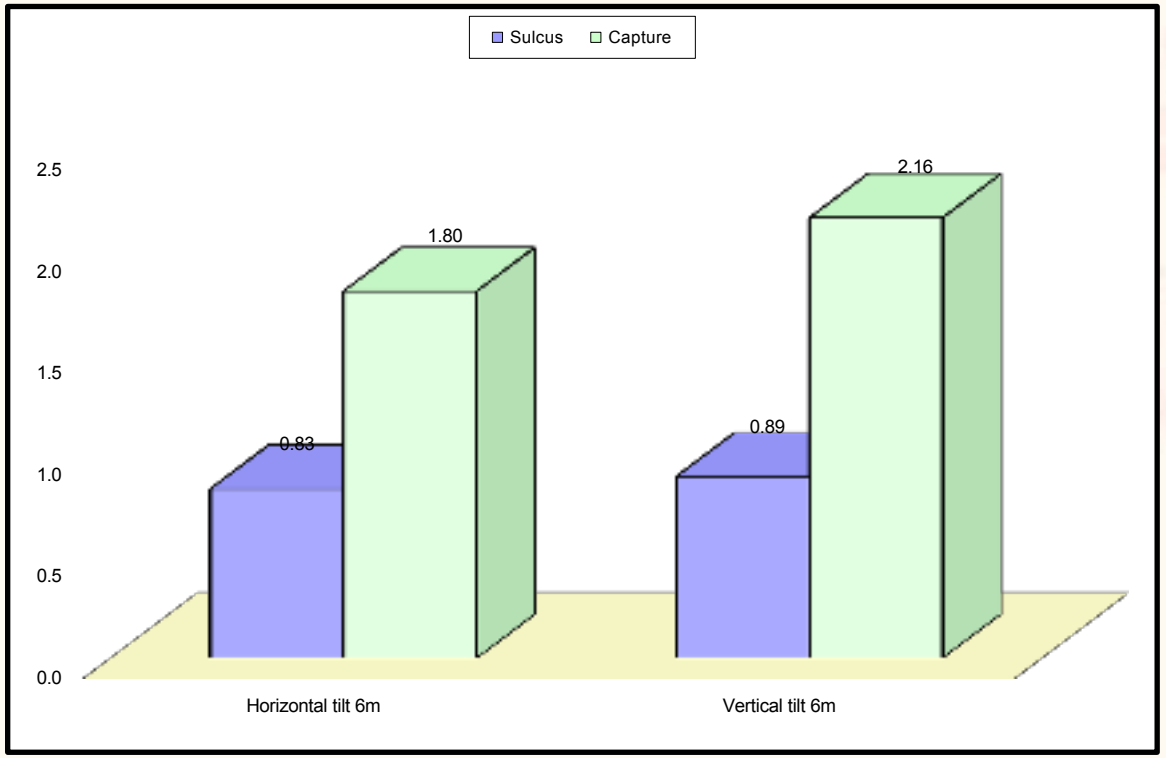

Capture




Sulcus

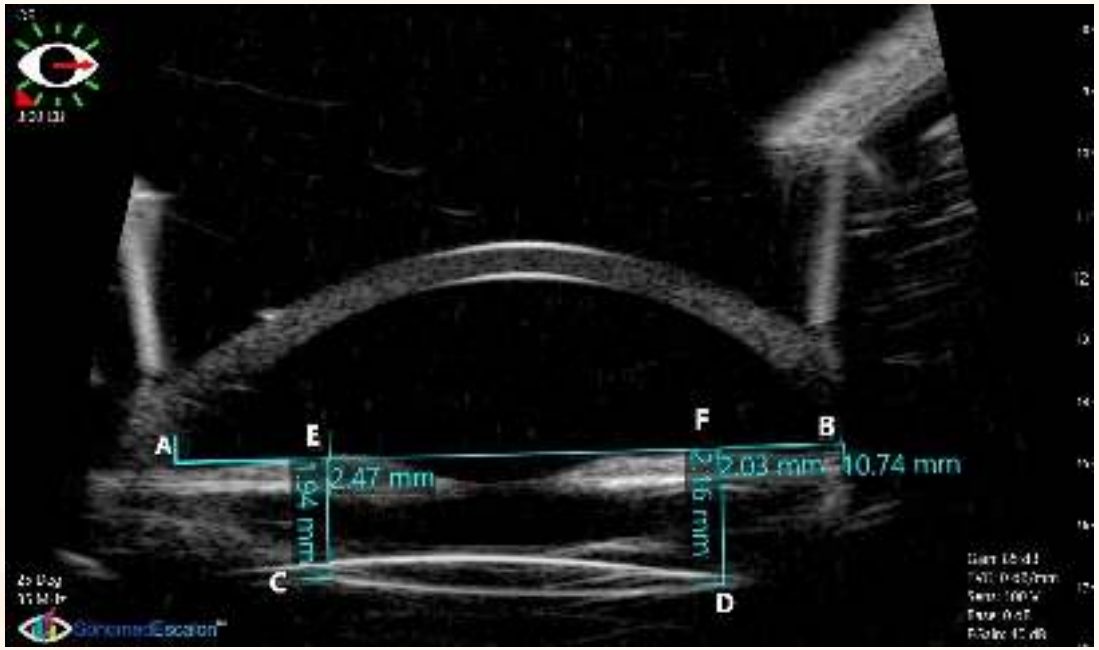
# Tilt

180 ° meridian ( 0.83 ° vs 1.8° ) and 90 ° meridian ( 0.89° vs 2.16° )

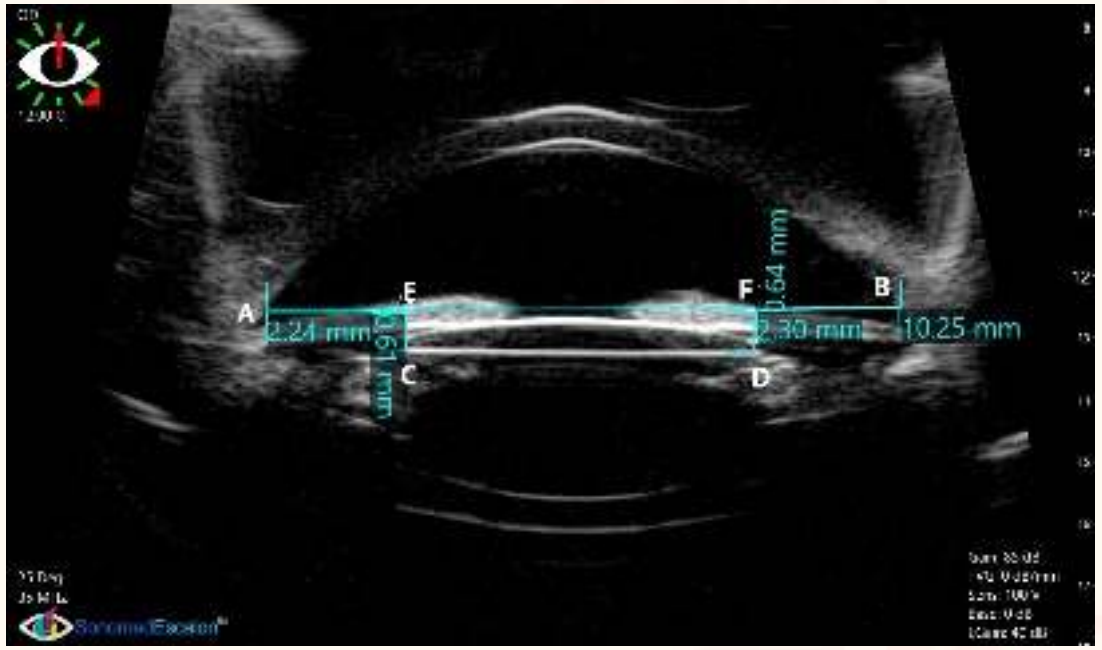


# Decentration *(6 months)*

**There were <u>no statistically significant</u> differences observed between both groups in terms of horizontal and vertical decentration**




Capture



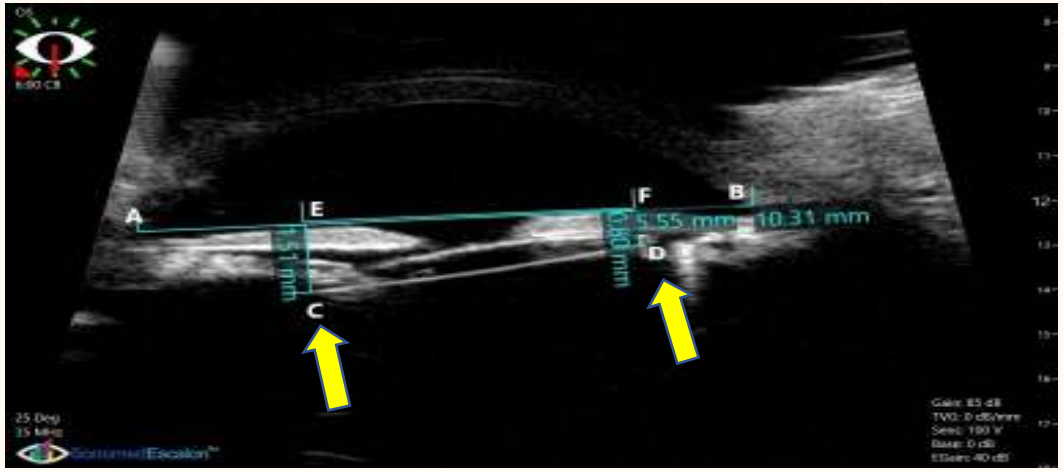

Sulcus

# Comparison of the studied parameters between sulcus group and capture group at 6 months

| | | Sulcus | Capture | Test-value | P-value | Sig. |
|---|---|---|---|---|---|---|
| | | No.=22 | No.=22 | | | |
| CCT (microns) | Mean±SD | 547.5 ± 41.02 | 559.09 ± 34.04 | -1.020 | 0.314 | NS |
| | Range | 430 – 670 | 460 – 610 | | | |
| ACD (mm) | Mean±SD | 3.01 ± 0.25 | 3.6 ± 0.59 | -4.317 | 0.000 | HS |
| | Range | 2.55 – 3.33 | 2.25 – 4.45 | | | |
| Superior angle (degrees) | Mean±SD | 42.47 ± 2.72 | 46.38 ± 4.42 | -3.527 | 0.001 | HS |
| | Range | 40 – 50 | 35.8 – 53 | | | |
| Inferior angle (degrees) | Mean±SD | 42.28 ± 2.72 | 45.8 ± 4.89 | -2.951 | 0.005 | HS |
| | Range | 38 – 46 | 34 – 52 | | | |
| Nasal angle (degrees) | Mean±SD | 42.76 ± 2.89 | 46.76 ± 4.1 | -3.739 | 0.001 | HS |
| | Range | 38.3 – 50 | 36 – 53.4 | | | |
| Temporal angle (degrees) | Mean±SD | 42.23 ± 2.32 | 47.09 ± 4.35 | -4.614 | 0.000 | HS |
| | Range | 39 – 49 | 37 – 53 | | | |
| Horizontal tilt (degrees) | Mean±SD | 0.83 ± 0.58 | 1.8 ± 1.22 | -3.379 | 0.002 | HS |
| | Range | 0.15 – 3 | 0.05 – 4.5 | | | |
| Vertical tilt (degrees) | Mean±SD | 0.89 ± 0.7 | 2.16 ± 1.91 | -2.923 | 0.006 | HS |
| | Range | 0.1 – 2.42 | 0.09 – 7 | | | |
| Horizontal decentration (mm) | Mean±SD | 0.31 ± 0.19 | 0.22 ± 0.13 | 1.988 | 0.053 | NS |
| | Range | 0.03 – 0.75 | 0.04 – 0.56 | | | |
| Vertical decentration (mm) | Mean±SD | 0.31 ± 0.31 | 0.28 ± 0.13 | 0.386 | 0.701 | NS |
| | Range | 0.05 – 1.2 | 0.01 – 0.6 | | | |

# Postoperative complications

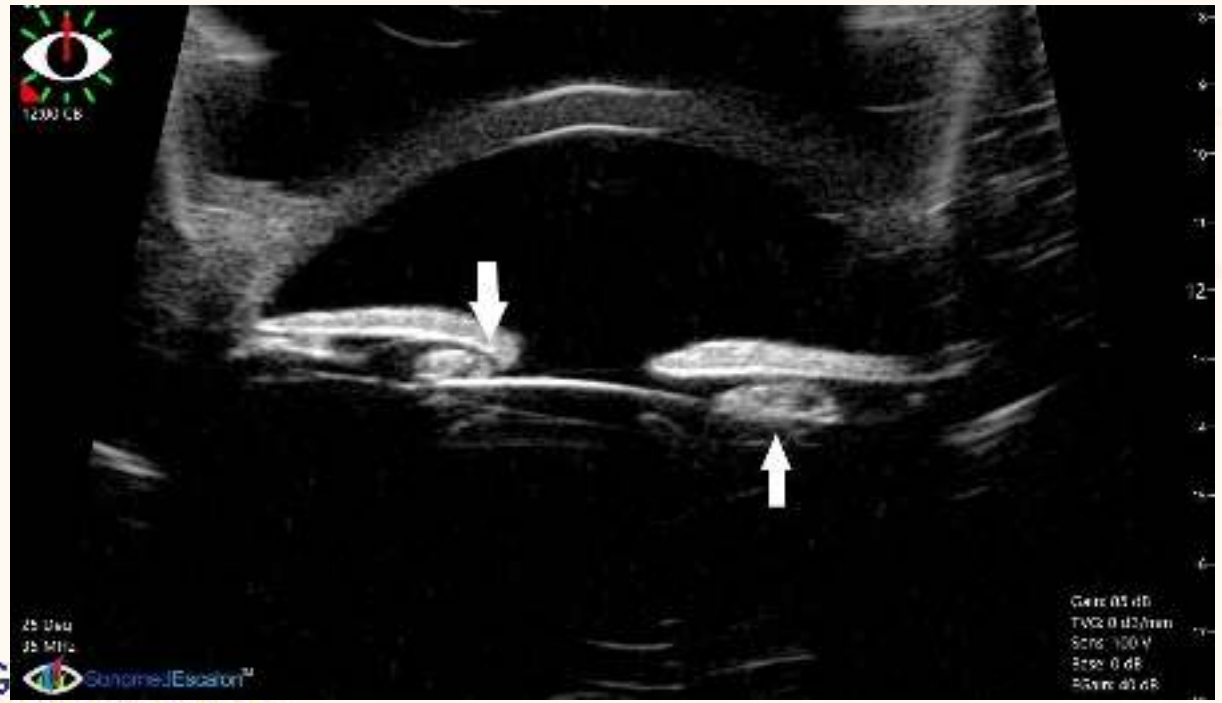
- **In 4 eyes in the *capture group*,** one edge of the optic had slid out of the captured position and was back in the ciliary sulcus despite confirmation of proper capture during surgery resulting in a **sulcus-capture position** causing a notable IOL tilt.




- **Two eyes** in the ***sulcus group*** experienced traumatic **anterior dislocation** of the IOL

# Postoperative complications

- Despite complete opening and removal of the Soemmerring ring in all cases, follow-up UMB imaging revealed re-proliferation of the ring in some cases.



# Target and postoperative refraction

| | | Sulcus | Capture | Test-value | P-value | Sig. |
|---|---|---|---|---|---|---|
| | | No.=22 | No.=22 | | | |
| Axial length (mm) | Mean±SD | 20.58 ± 1.16 | 20.03 ± 1.02 | 1.658• | 0.105 | NS |
| | Range | 19.08 – 23.51 | 18.2 – 22.1 | | | |
| Target refraction TR (Diopters) | Mean±SD | +2.57 ± 0.41 | +2.83 ± 0.81 | -1.331• | 0.190 | NS |
| | Range | (+2) – (+3.25) | (+1.92) – (+5) | | | |
| Sphere (Diopters) after surgery | Mean±SD | +1.5 ± 1.22 | +3.95 ± 1.91 | -5.084• | 0.000 | HS |
| | Range | (-1.5) – (+4) | (-1) – (+7) | | | |
| Cylinder (Diopters) after surgery | Mean±SD | -1.51 ± 1.27 | -1.98 ± 0.78 | 1.462• | 0.151 | NS |
| | Range | (-4) – (+0.75) | (-3) – (+0) | | | |
| Spherical equivalent SE(Diopters) | Mean±SD | +0.69 ± 1.13 | +3.1 ± 1.54 | -5.913• | 0.000 | HS |
| | Range | (-1.75) – (+3.25) | (-1.25) – (+5.5) | | | |
| Difference between SE and TR (Diopters) | Mean±SD | -1.88 ± 1.33 | +0.75 ± 1.47 | 4.172 | 0.000 | HS |
| | Range | (-4.75) – (+0.9) | (-4.25) – (+2.59) | | | |
| Complications | No | 20 (90.9%) | 20 (90.9%) | 0.000* | 1.000 | NS |
| | Yes | 2 (9.1%) | 2 (9.1%) | | | |

# Discussion

- **Significantly wider AC angles in the capture group** suggests that this technique may help to reduce the occurrence of *glaucoma and glaucoma-related complications*. (Long-term FU)

- **More tilt in the capture group** *–even after exclusion of the 4 sulcus-capture cases-* unequal circumferential thickness of the capsular rim with thicker areas pushing the adjacent edge of the IOL optic further posteriorly thereby inducing the tilt.

# Potential advantages of optic capture technique

- Cases where complete opening of the sulcus could not be achieved at the time of implantation
- Cases with narrow anterior chamber angles
- Eyes where the diameter of the ciliary sulcus exceeds the overall diameter of the IOL such as highly myopic eyes
- When a postoperative inflammatory response is anticipated such as patients with cataract and uveitis

# Limitations

- Small sample size
- Short follow-up that precluded detection of long-term possible effects of both techniques

# Conclusion

- Secondary IOL implantation with capture technique appears to provide a **deeper anterior chamber** and a **wider angle** than sulcus implantation but could result in **more IOL tilt**.

- UBM discloses changes in IOL position that are not clinically detected during follow-up.

# Thank you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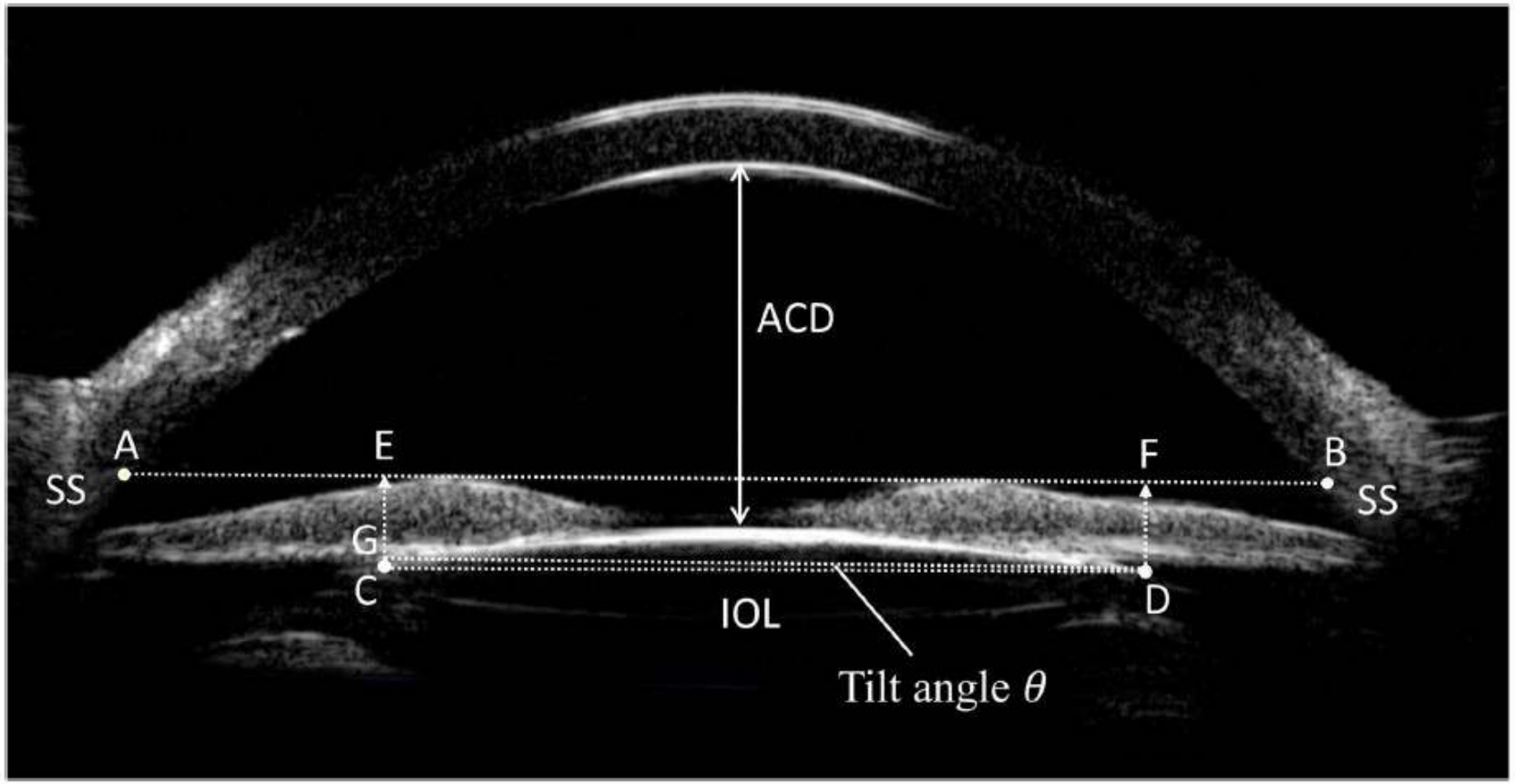


**Fig 1. Measurement of the anterior chamber depth (ACD) and intraocular lens (IOL) decentration and tilt on the ultrasound biomicroscopy image of the anterior segment.** ACD was determined from the central inner corneal surface, perpendicular to the corneal surface to the most anteriorly visible part of the IOL. A line (line AB) was drawn between the two scleral spurs (SSs), as the base line of reference for IOL position. Two perpendicular lines were drawn from both optical endpoints of the IOL (C and D) to the base line with intersection points (E and F). IOL decentration was equal to half of the differences between distance AE and FB, i.e. IOL decentration = (|AE —FB|) / 2. IOL tilt was determined by the angle ($\theta$) formed by the line between the two optical endpoints and the base line. A line parallel to line AB was drawn intersecting one of the optical endpoints (D). Angle θ was calculated with following formula:

$$\theta = \arctan\left(\frac{CG}{DG}\right) \times \frac{180}{\pi} = \arctan\left(\frac{|CE - DF|}{EF}\right) \times \frac{180}{\pi}$$