Role of AS OCT in PAC family

Hossein Ghavami Shahri, MD
Assistant Professor of Ophthalmology
MUMS

أَلَمْ نَجْعَلْ لَهُ عَيْنَيْنِ

Role of AS OCT in PAC family

prevalence of PACG 23.36 million and 32.04 million in 2040

80% of cases found in Asia

PACG is a more aggressive form of glaucoma , three times higher risk of blindness

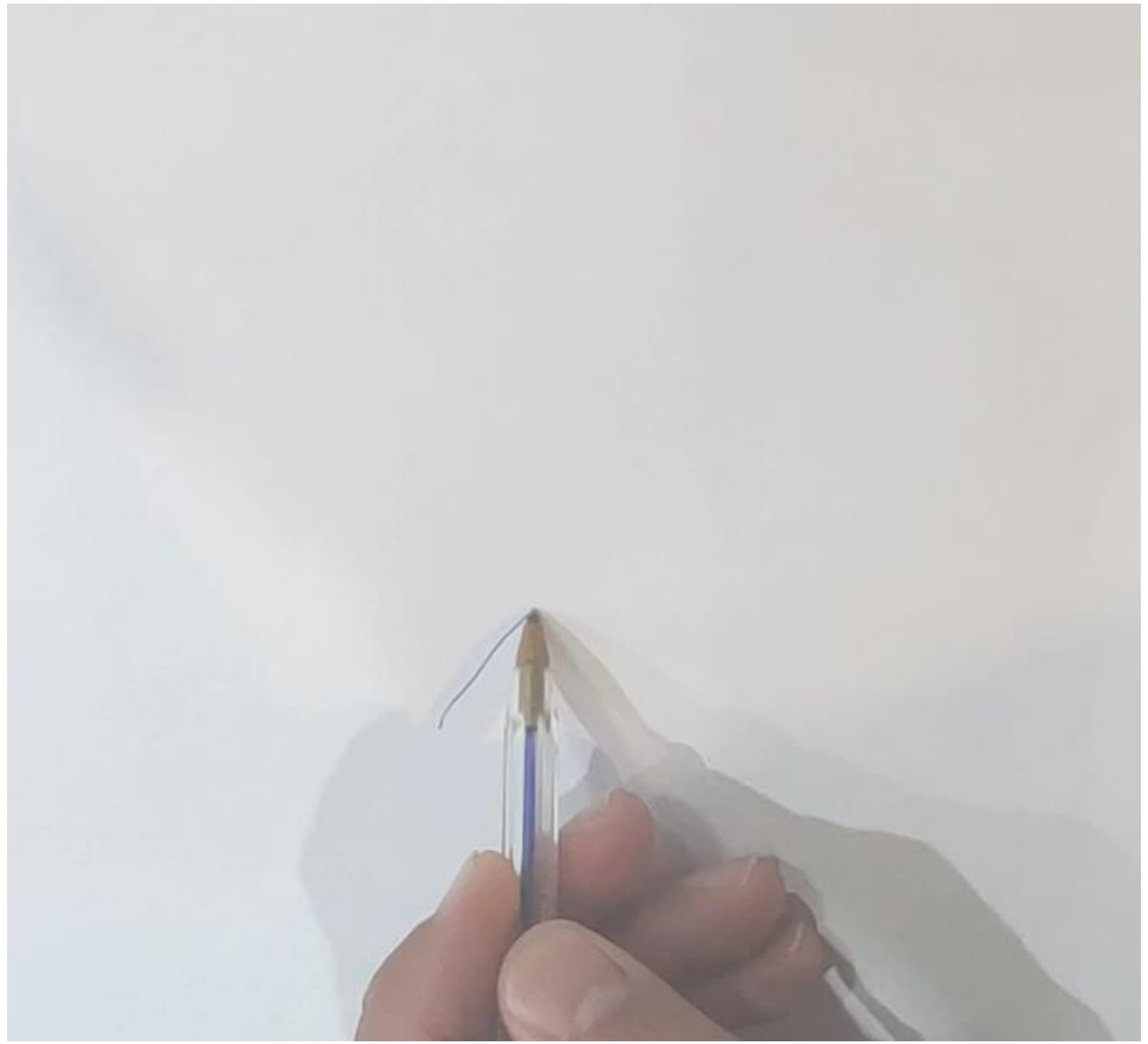
26% of glaucoma cases, it causes almost half of the blindness

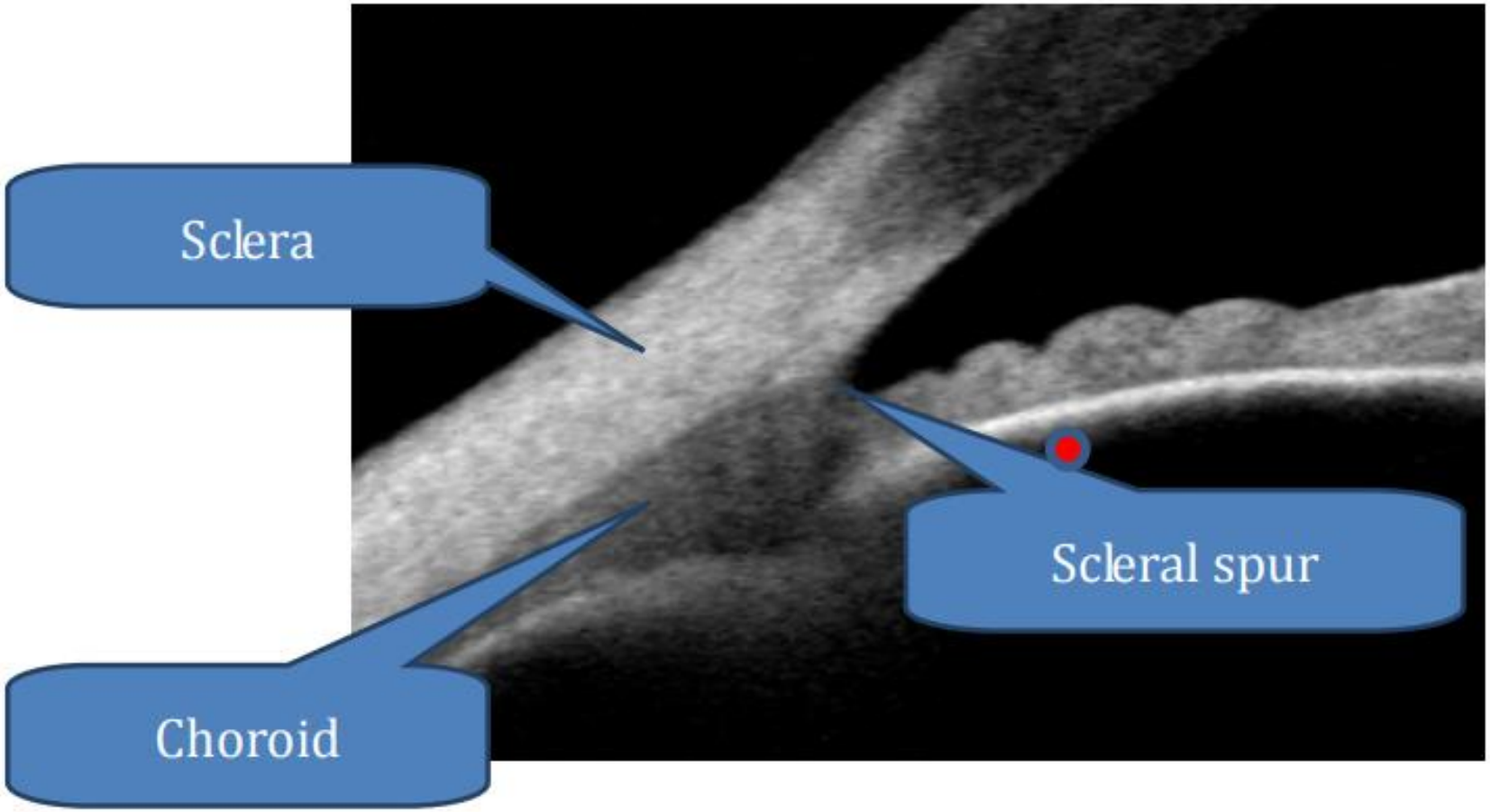
underdiagnosed worldwide, In China, over 90% of PACG undiagnosed in 2010

frequently misdiagnosed,two-thirds of misdiagnosed as POAG in Indian study

25% PACS will progress to PAC in 5 years

30% of PAC will progress to PACG within 5 years




Sclera
Scleral spur
Choroid

Role of AS OCT in PAC family

As an adjunct to gonioscopy and evaluation of PAS

Mechanistic evaluation of PACD and treatment outcomes

As A predictor of development of angle closure and IOP fluctuation

AS-OCT assessment parameters

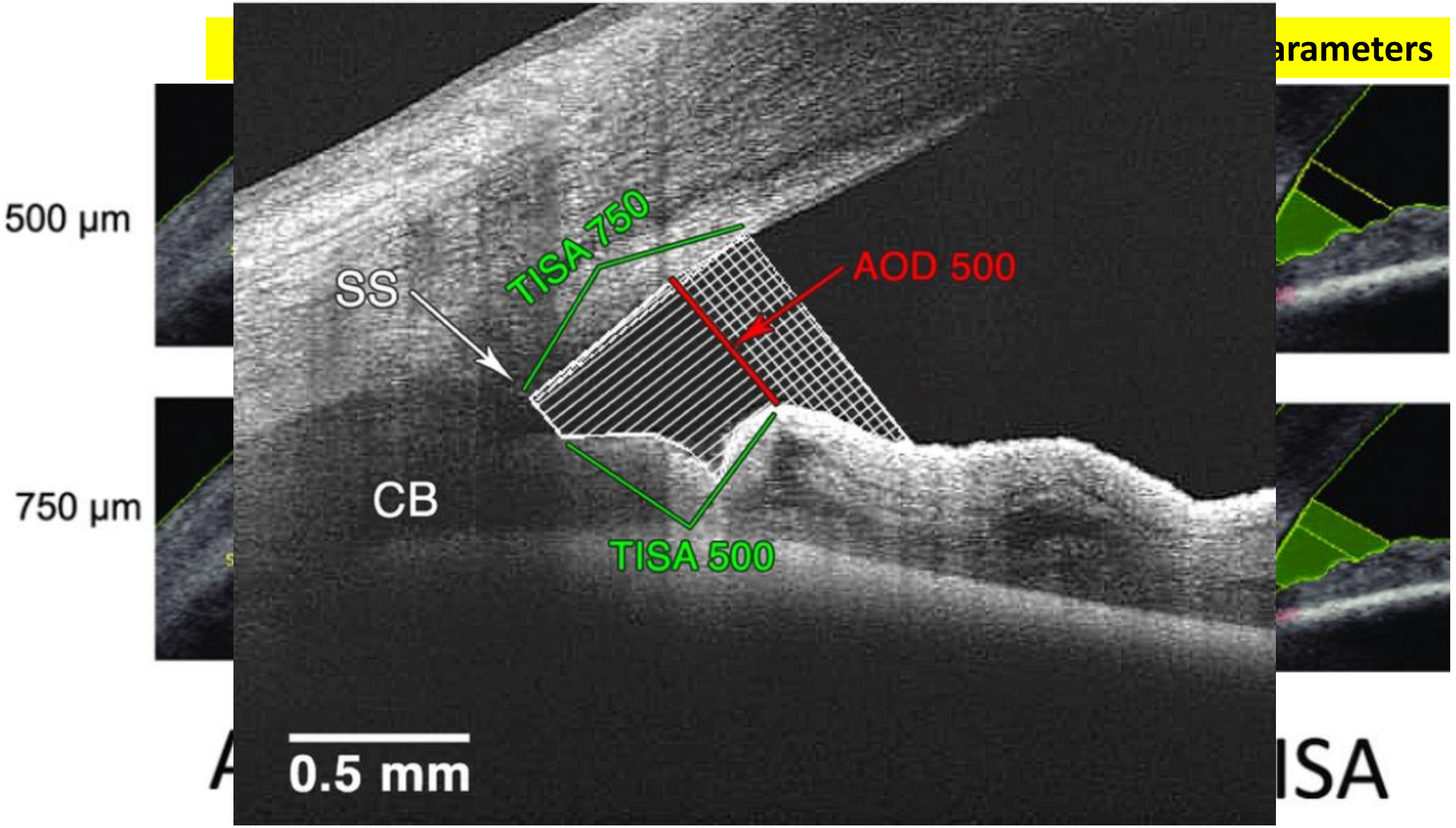
Angle assessment

- **Linear: AOD , TIA**
- **Non linear(area): ARA , TISA**

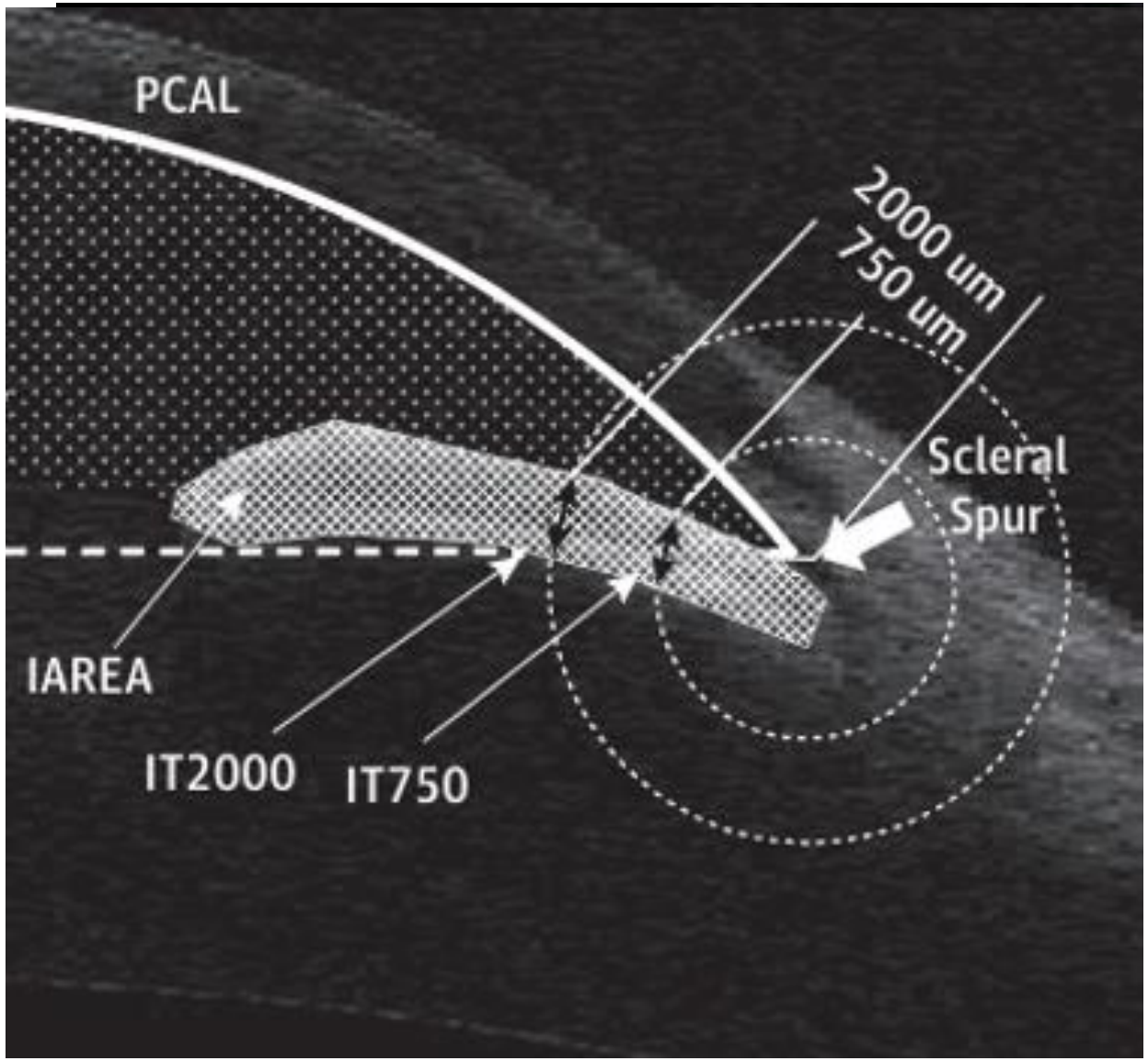
Factors beyond the angle

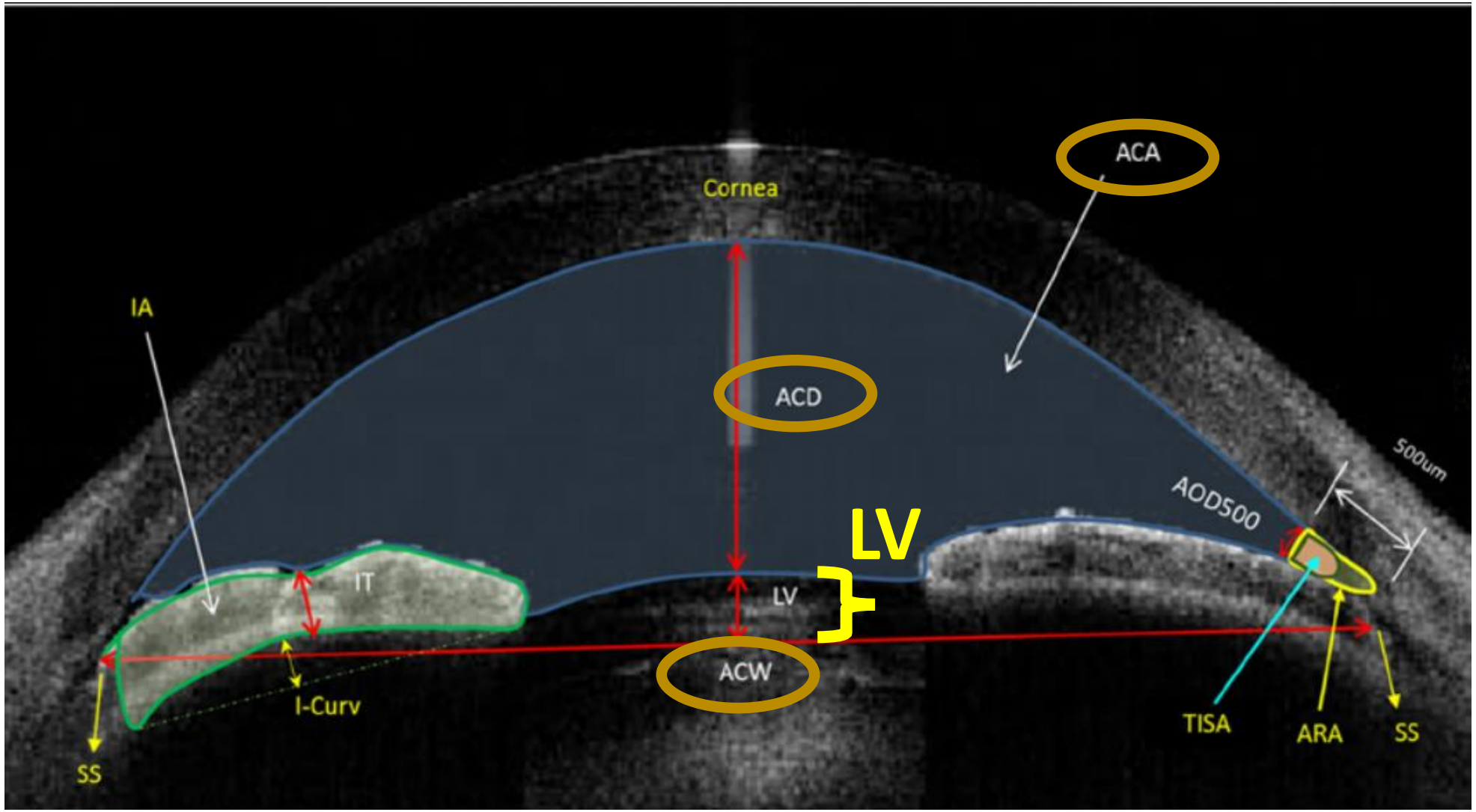
- **Iris factors: IT , IC , IA , IV**
- **Lens factor: LV , CLR , AV**
- **Anterior chamber factors: ACD , ACW , ACA . ACV**

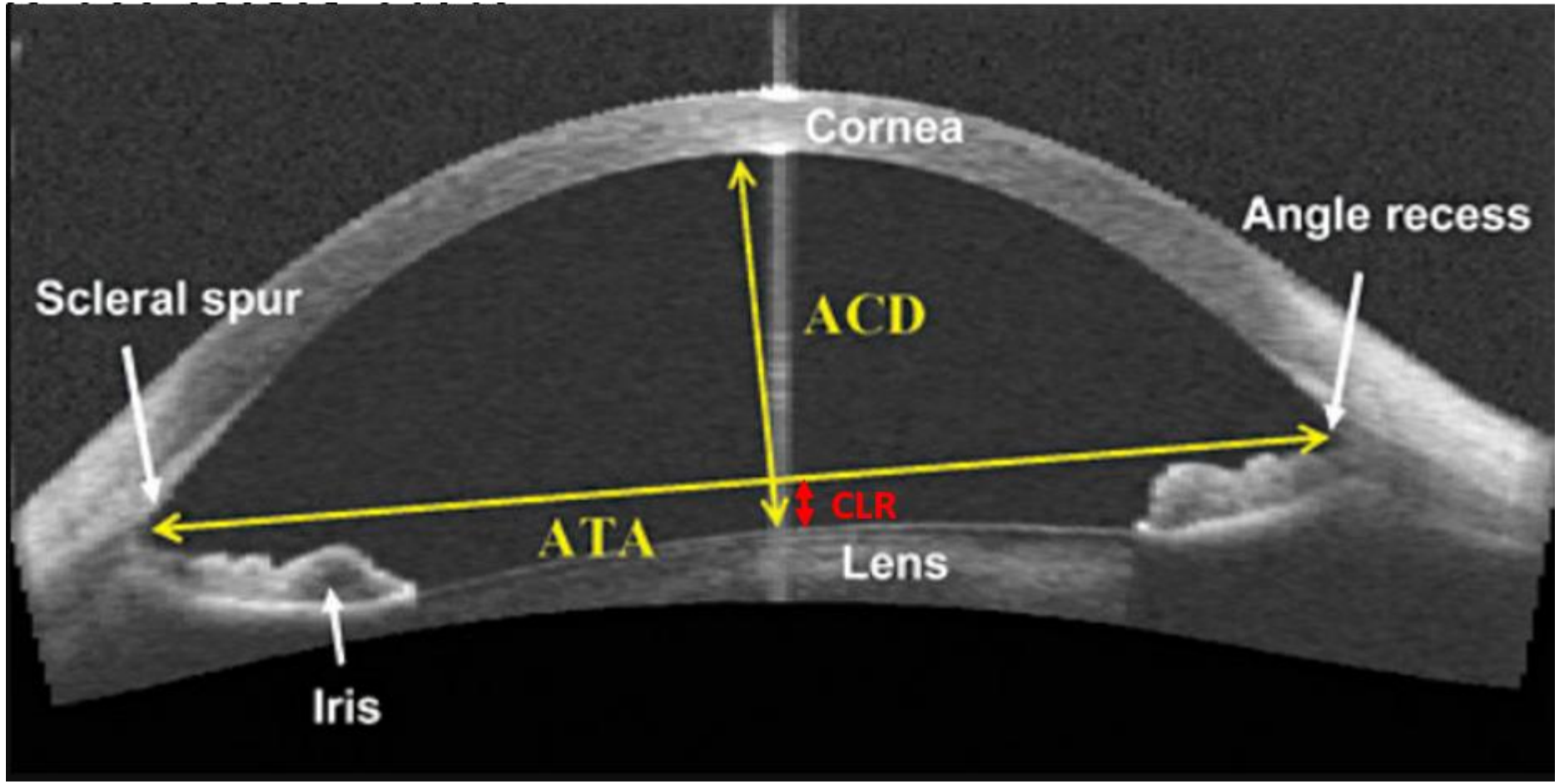
arameters



ISA


PCAL
2000 um
750 um
Scleral
Spur
IAREA
IT2000
IT750

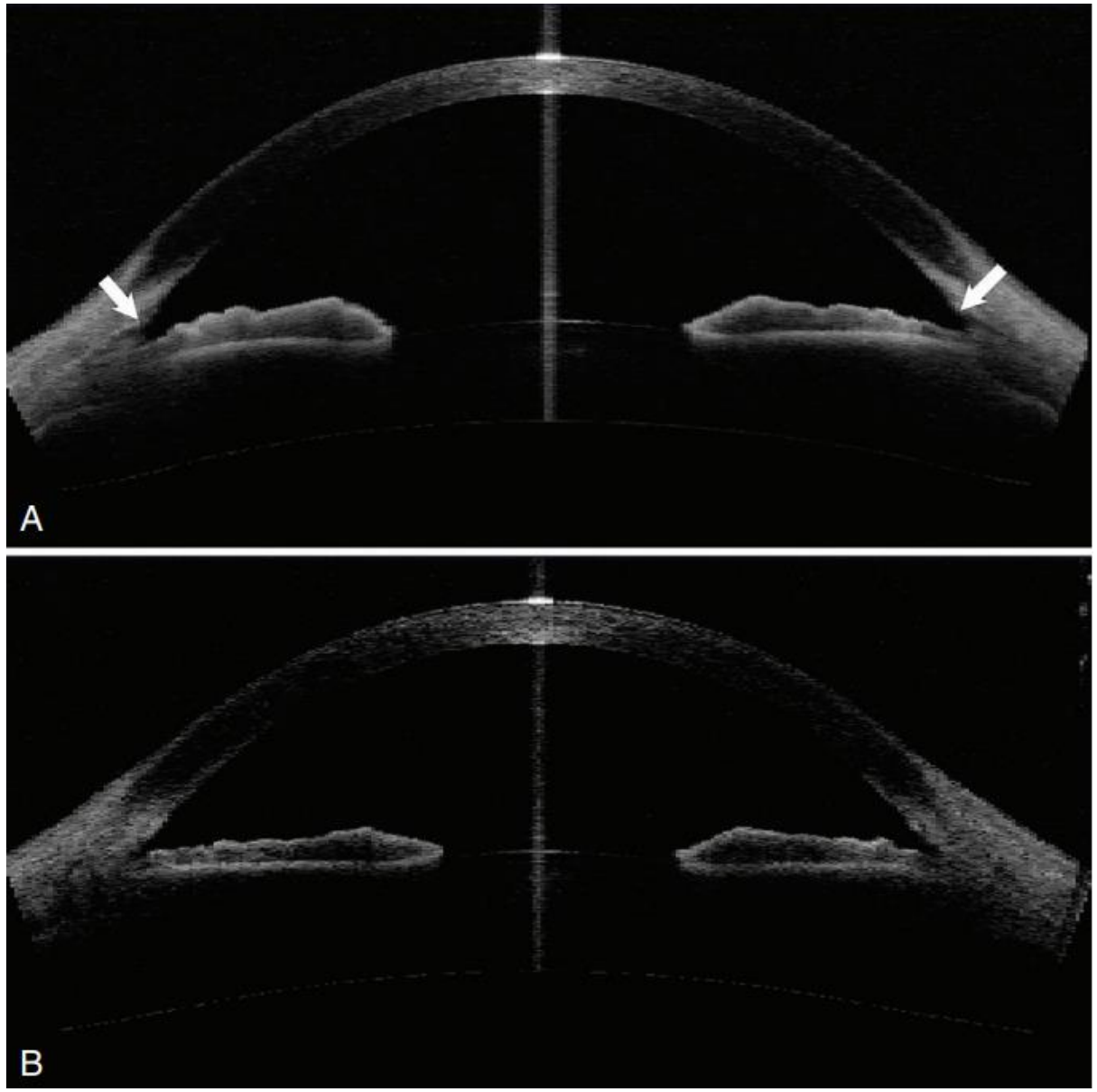

ACA
Cornea
IA
ACD
500um
AOD500
LV
IT
LV
ACW
I-Curv
SS
TISA
ARA
SS

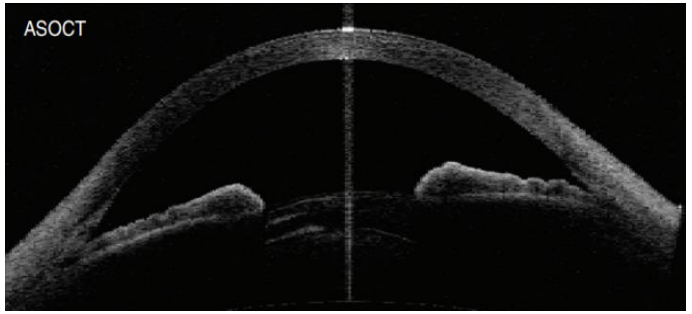

Cornea
Angle recess
Scleral spur
ACD
CLR
ATA
Lens
Iris

AS-OCT of scleral spur.
(A) AS-OCT image showing well-defined scleral spurs
(B) AS-OCT image with poorly defined scleral spurs

15–28% of AS-OCT unable to identify scleral spur
especially in eyes with angle closure

presence or absence of angle closure could still be assessed qualitatively in more than 90%

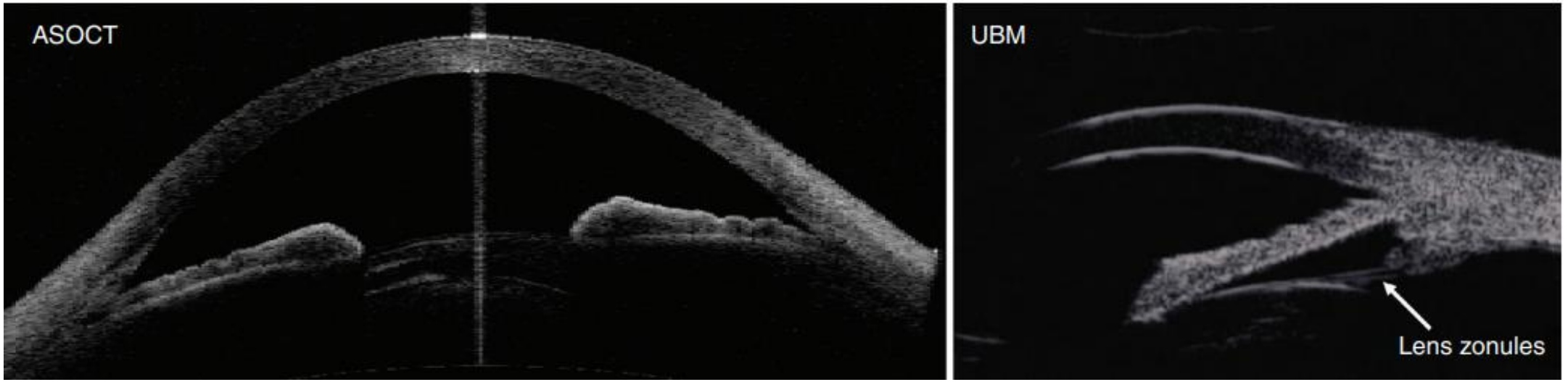




AS OCT vs Gonioscopy

- significant skill ,(signifcant barrier)
- compliance from patients , contact with the eye
- only fair repeatability , poor reproducibility

- neovascularisation
- real-time dynamic indentation gonioscopy , PAS
- remains current reference standard for PAS detection
- pigment dispersion syndrome
- angle recession
- 360-degree visualisation of anterior angle

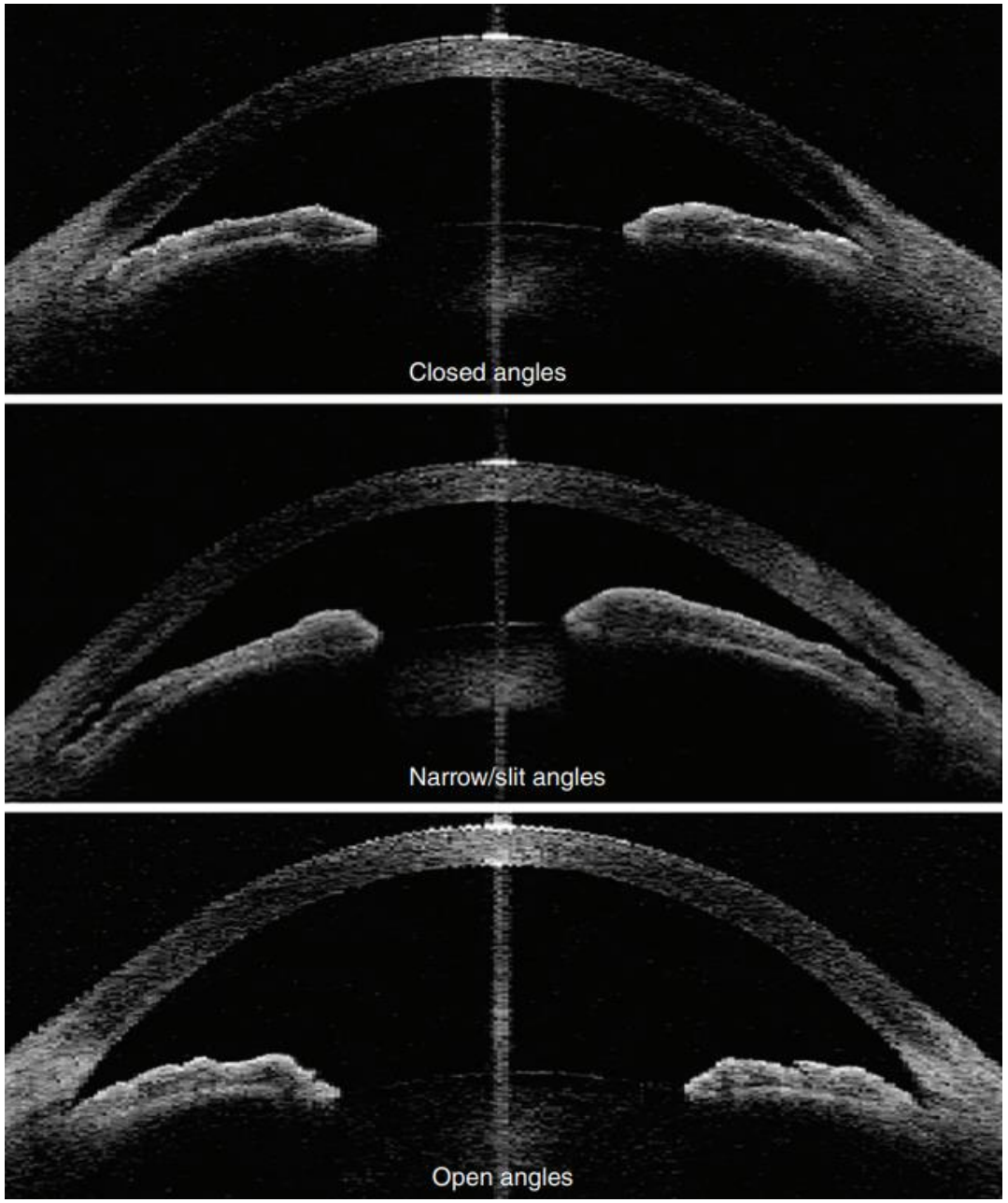


AS-OCT vs UBM. UBM and AS-OCT images of same eye showing ability of UBM to image structures posterior to the iris such as the ciliary body and lens zonules.

- inability to image structures posterior to the iris
- difficulty in the manual localization of scleral spur
- quantitative parameters cut off points vary according to race, sex, device, and definition of angle closure.
- there is no trend analysis of the quantitative parameters obtained from AS-OCT.

Cut off between PAC and Non PAC ???

<u>Narrow but open angle</u>
subjective



Detection of Primary Angle Closure Using Anterior Segment Optical Coherence Tomography in Asian Eyes

Winifred P. Nolan, MD, FRCOphth • Jovina L. See, MRCS(Ed) • Paul T.K. Chew, FRCS(Ed), FRCOphth • ... Ce Zheng, MSc, MD • Paul J. Foster, PhD, FRCS(Ed) • Tin Aung, PhD, FRCS(Ed) • Show all authors

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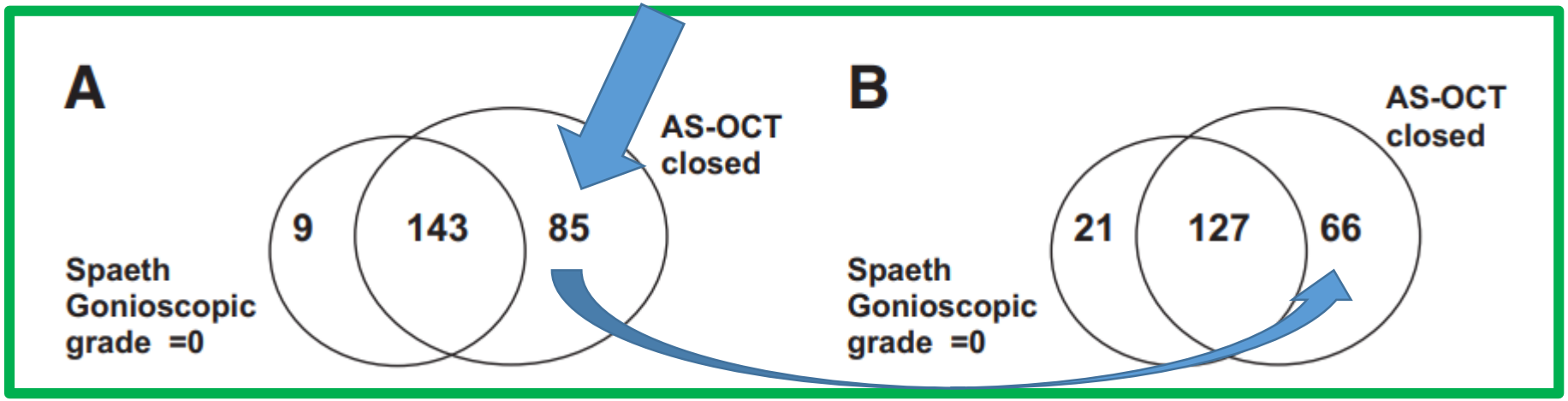
Conclusion

It is highly sensitive in detecting angle closure when compared with gonioscopy.

More persons are found to have closed angles with AS-OCT than with gonioscopy.

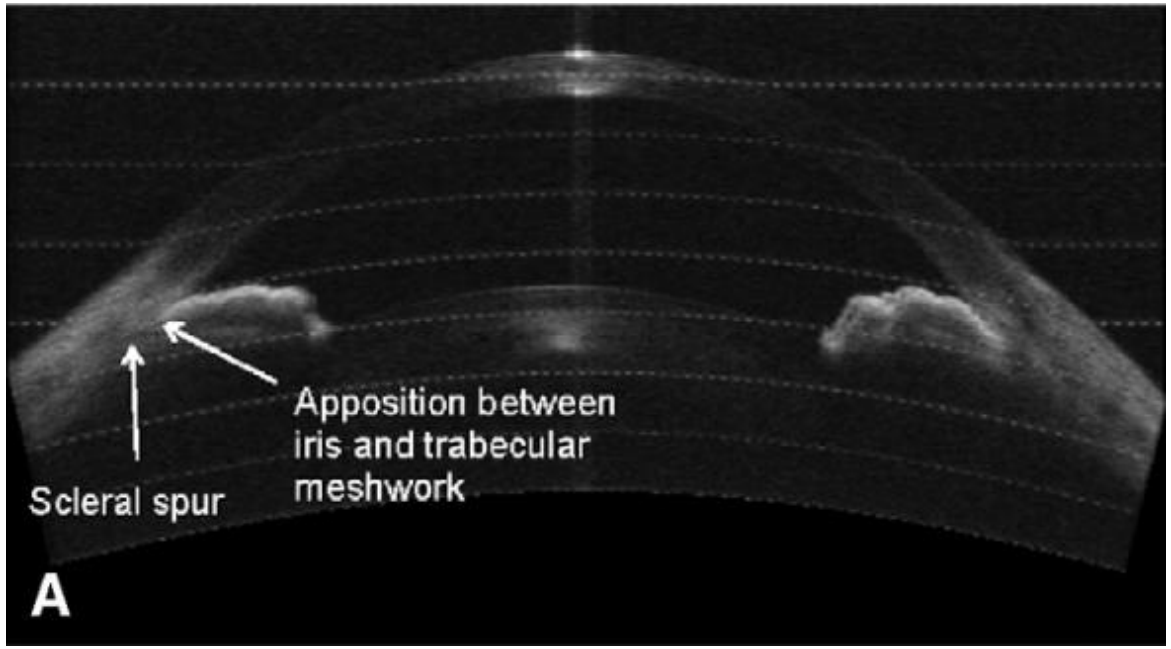
AS-OCT identified 1 quadrants as closed in 85 eyes that were apparently open in all 4 quadrants on gonioscopy

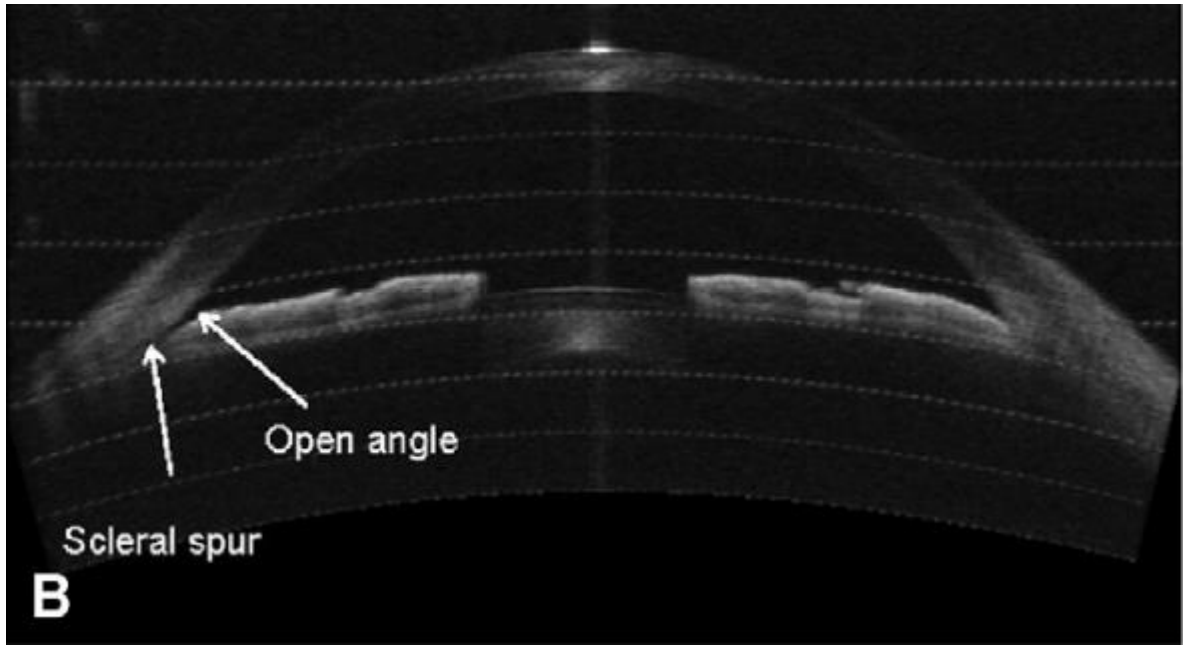


- Using gonioscopy as a reference standard results in AS-OCT having a sensitivity of 98%.
- This disparity resulted in low specificity for AS-OCT when using gonioscopy as a gold standard.

several possible explanations

- Differences in lighting conditions
- Distortion of anterior segment by gonioscopy
- Landmarks are not same using 2 methods





A, Both angles are closed when imaging is performed in dark conditions. B, The angle has widened when imaging is repeated with room lights on.

If we turn things around and assess data using AS-OCT as reference standard to examine performance of gonioscopy, we find that gonioscopy has low sensitivity (68.3%) and high specificity (96.6%)

good sensitivity corresponds to a strong NPV

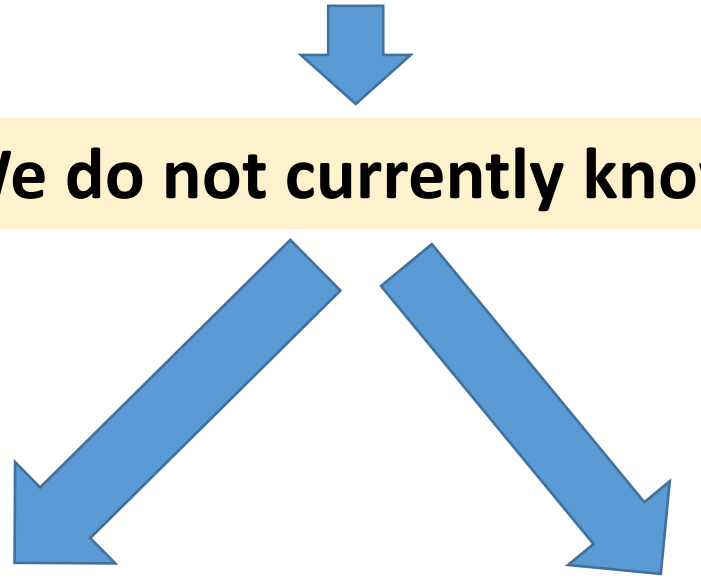
a place for AS-OCT in ruling out angle closure

A negative result

- in situations where a practitioner skilled in gonioscopy is not available
- telehealth consultations or in primary care practice

Despite AS-OCT generally showing specifcity above 80%,
prevalence of angle closure is low enough that PPV was often less than 50%.
A positive result becomes difficult to interpret and would necessitate further testing.

Using Gonioscopy As Reference Standard To Defne Angle Closure



We do not currently know

if these false-positive errors are truly errors

if they represent eyes at greater risk of angle closure

Pre Gonioscopic Angle Closure

AMERICAN ACADEMY OF OPHTHALMOLOGY
The Eye M.D. Association

Anterior Segment Imaging Predicts Incident Gonioscopic Angle Closure

Mani Baskaran, DNB,[1,2,3] Jayant V. Iyer, MBBS, MMed,[1] Arun K. Narayanaswamy, DNB, MMed,[1] Yingke He, BSc(Hons),[2] Lisandro M. Sakata, MD, PhD,[4] Renyi Wu, MD, PhD,[1,5] Dianna Liu, MD,[6] Monisha E. Nongpiur, MD,[1,2,3] David S. Friedman, MD, PhD,[6,] Tin Aung, FRCS(Ed), PhD[1,2,3,*]*

Conclusions: Anterior segment OCT imaging at baseline predicts incident gonioscopic angle closure after 4 years among subjects who have gonioscopically open angles and iridotrabecular contact on AS OCT at baseline.

Pre Gonioscopic Angle Closure

JAMA Ophthalmology | Original Investigation

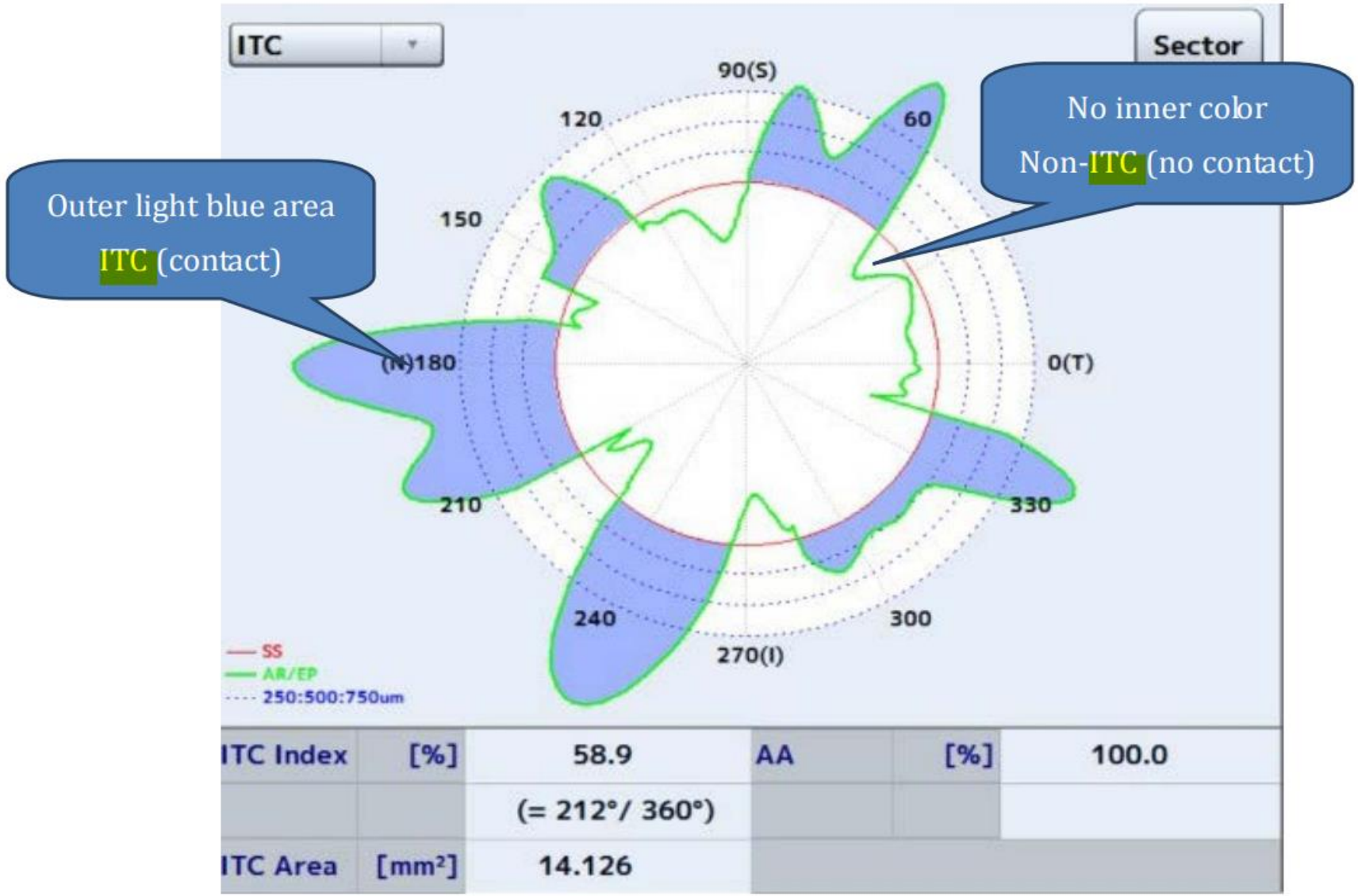
Association of Baseline Anterior Segment Parameters With the Development of Incident Gonioscopic Angle Closure

Monisha E. Nongpiur, MD, PhD; Inas F. Aboobakar, MD; Mani Baskaran, DNB, PhD; Arun Narayanaswamy, DNB, MMEd; Lisandro M. Sakata, MD, PhD; Renyi Wu, MD, PhD; Eray Atalay, MD; David S. Friedman, MD, PhD; Tin Aung, FRCS(ED), PhD

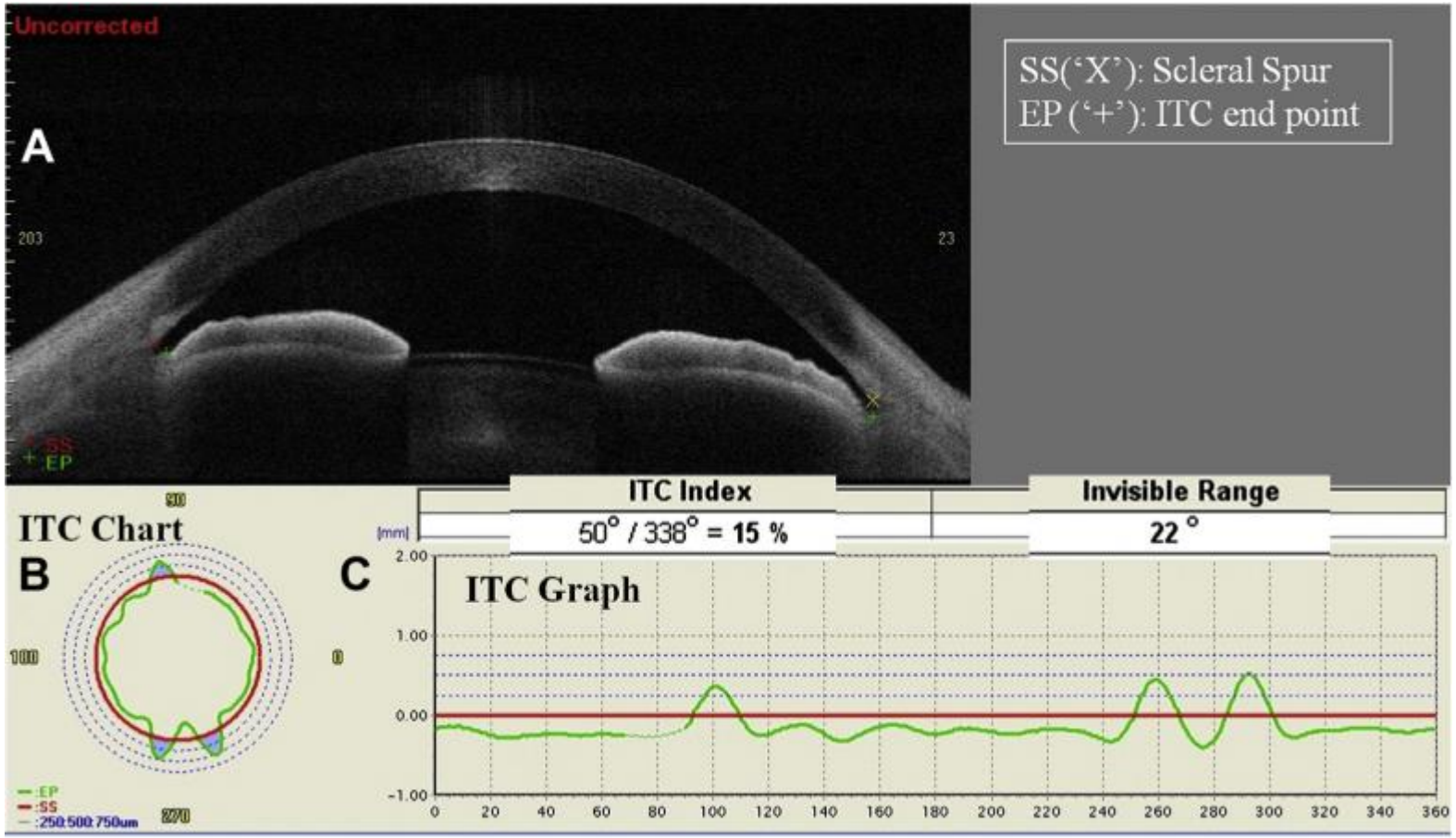
CONCLUSIONS

smaller AOD750 and larger LV measurements are associated with the development of incident gonioscopic angle closure after 4 years among participants with gonioscopically open angles at baseline.

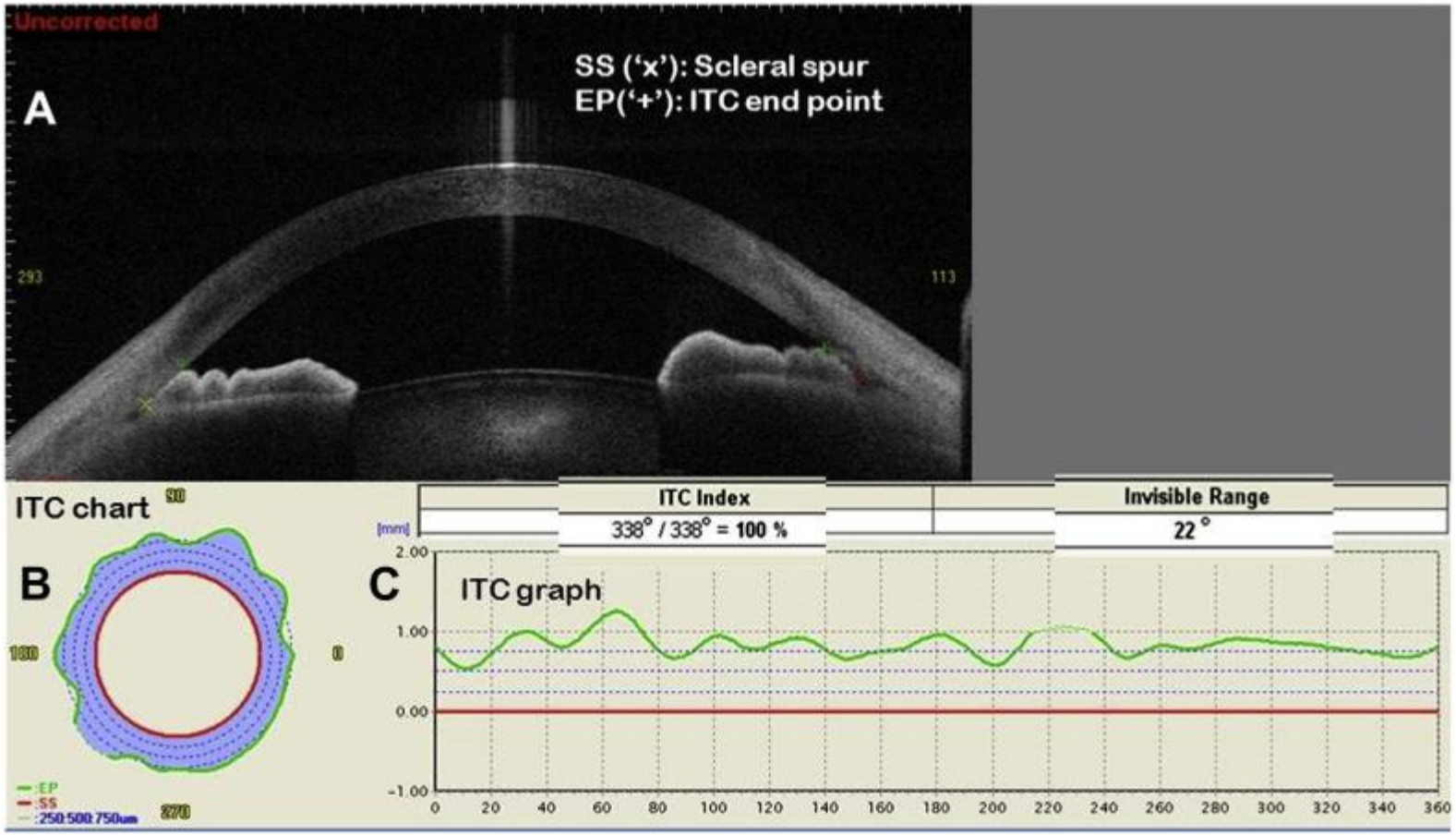
monitoring of patients with evidence of angle closure on AS-OCT, even if the angles appear open on gonioscopy


Outer light blue area
ITC (contact)
No inner color
Non-ITC (no contact)
ITC
Sector
90(S)
120
60
150
(N)180
0(T)
210
330
240
300
270(I)
SS
AR/EP
250:500:750um
ITC Index [%] 58.9 AA [%] 100.0
(= 212°/ 360°)
ITC Area [mm²] 14.126

(ITC) index analysis for an open angle



(ITC) index analysis for a closed-angle



ITC Result

Close

	ITC Index	ITC Area	AA
Total [0°, 360°)	18.9 % = 68 ° / 360 °	1.723 mm²	100.0 %
[-45°, 45°)	0.0 % = 0 ° / 90 °	0.000 mm²	100.0 %
[45°, 135°)	40.0 % = 36 ° / 90 °	1.313 mm²	100.0 %
[135°, 225°)	35.6 % = 32 ° / 90 °	0.410 mm²	100.0 %
[225°, 315°)	0.0 % = 0 ° / 90 °	0.000 mm²	100.0 %

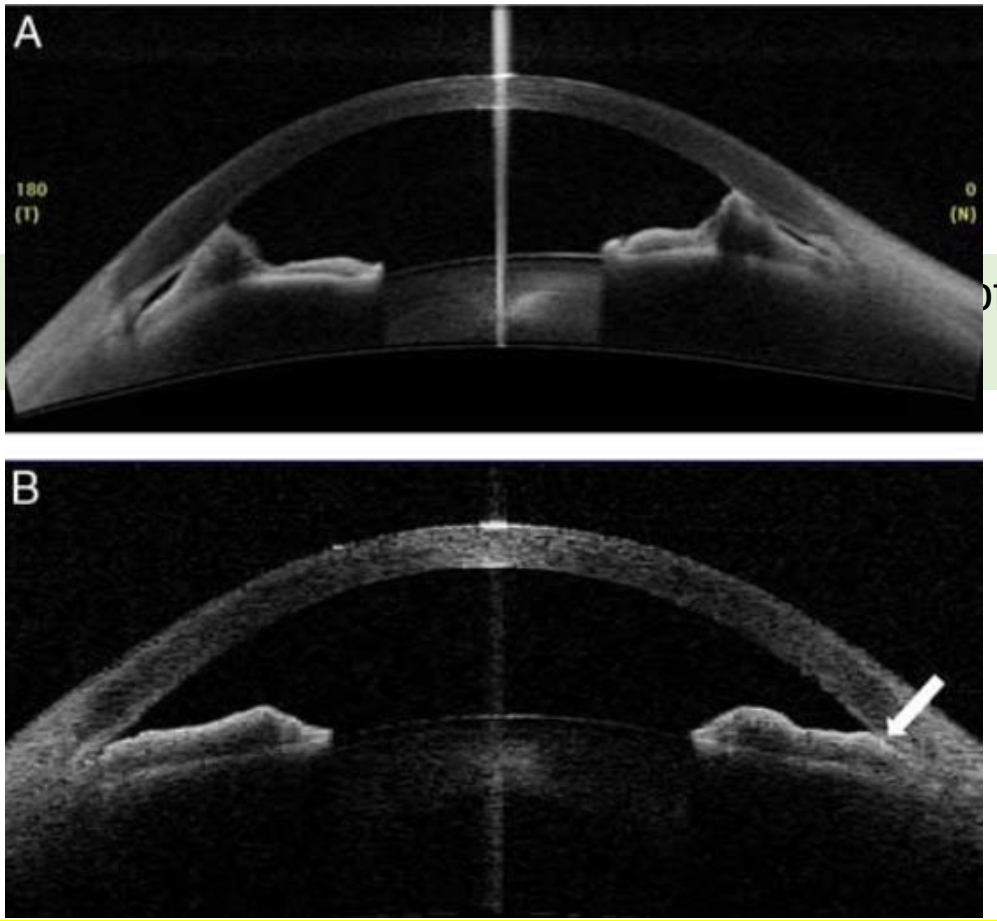
Considering angle closure in terms of percentage or degrees could be more accurate than more **limited cross-sectional assessment**.

ITC index showed a higher correlation with postoperative IOP reduction than ITC area, indicating that ITC-induced angle closure itself is more significant than the extent of ITC

The ITC index of >35% was found to be optimal for best classification for angle closure across various gonioscopic angle-closure definitions with a sensitivity of 71.9% and a specificity of 84.3% **for 2-quadrant angle-closure**.

discriminate synechial angle closure from appositional angle closure

varying lighting condition



of area and degree of PAS

Reflectivity Of PAS Appears To Be Higher (Hyperreflectivity)

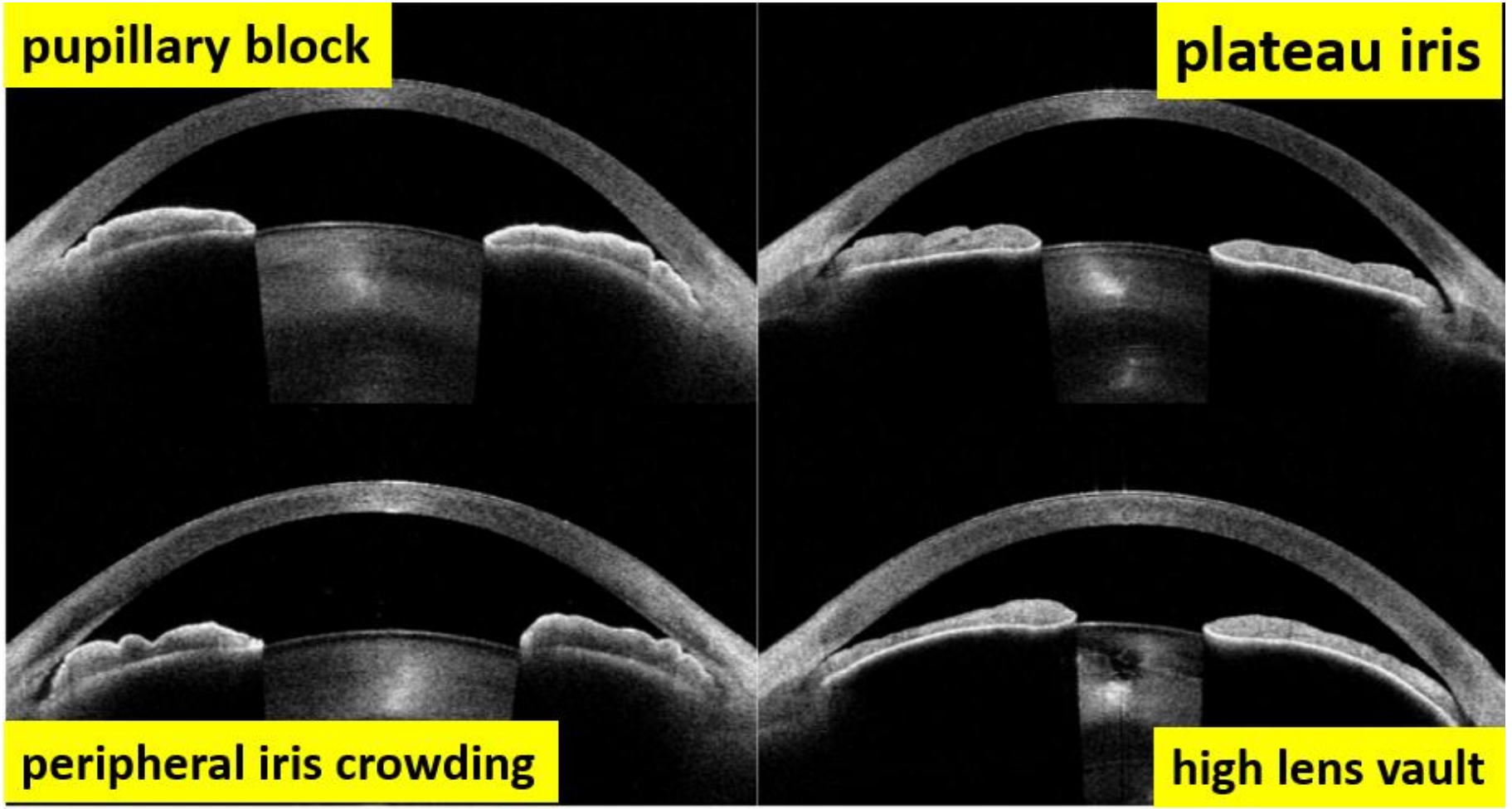
indentation gonioscopy remains gold standard to diagnose and quantify extent of PAS

- little correlation between degree of preoperative PAS and IOP control after cataract extraction in PACG.
- Possible explanations include:

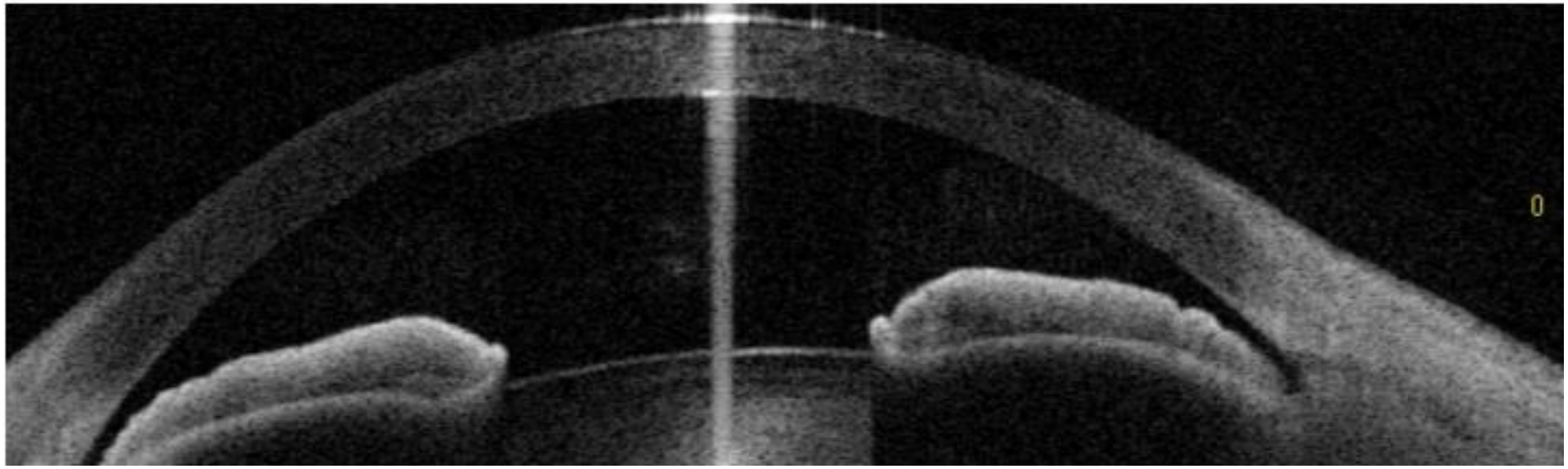
(1) It is difficult to ascertain extent of PAS in eyes with a large lens and shallow AC

(2) Surgical manipulation, such as viscoelastic agent injection and positive flushing pressure may resolve PAS that is of weak adherence

(3) Gonioscopic findings may not truly reflect extent of damage in trabecular outflow pathway as there is loss of trabecular cells and irregular architecture in areas away from visible PAS.



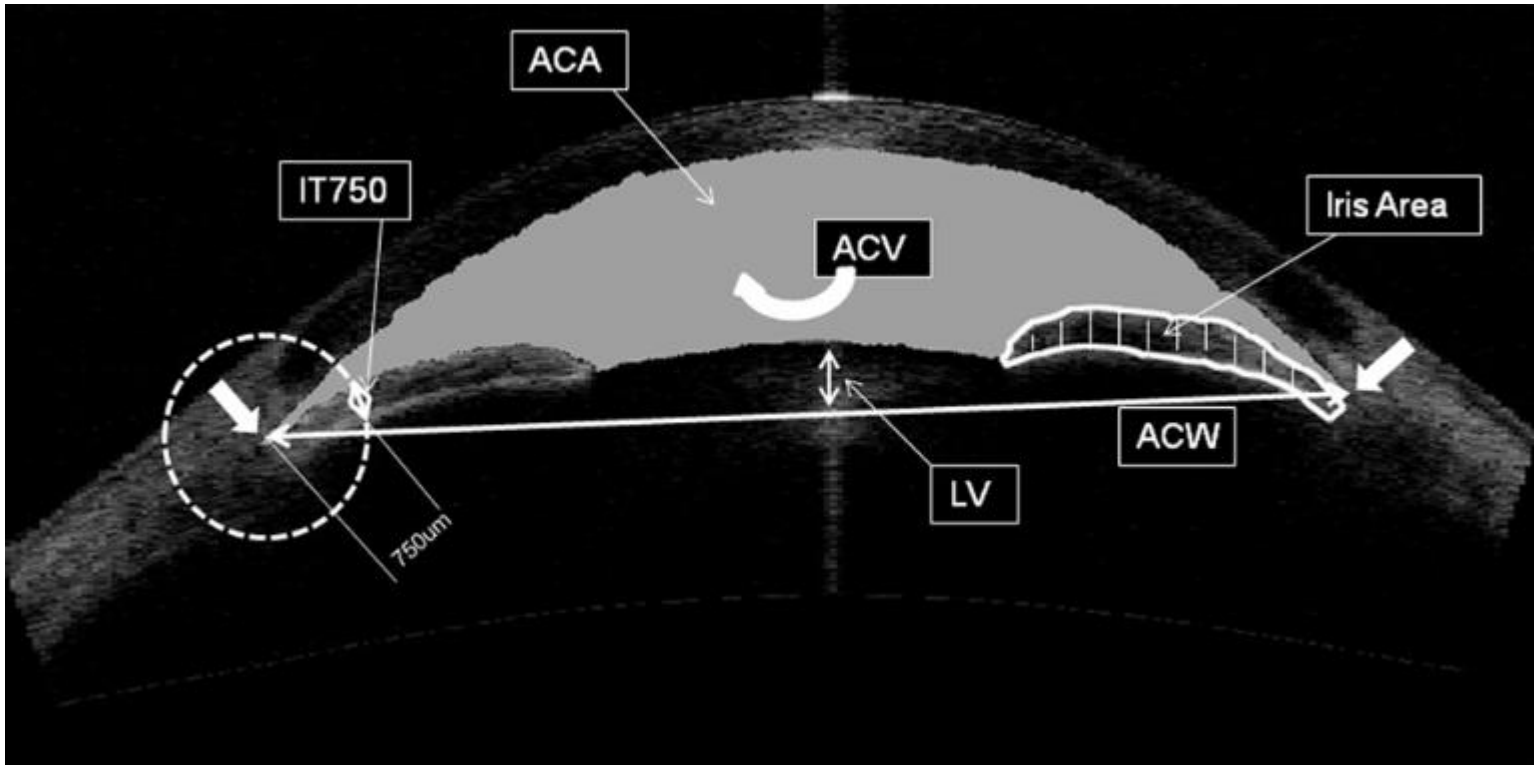
- Assessing angle closure is not to solely determine degree of angle narrowness
- but also to evaluate underlying anatomical and physiological mechanisms accounting for angle closure.
- more custom tailoring of therapeutic options and anticipation of treatment effects.



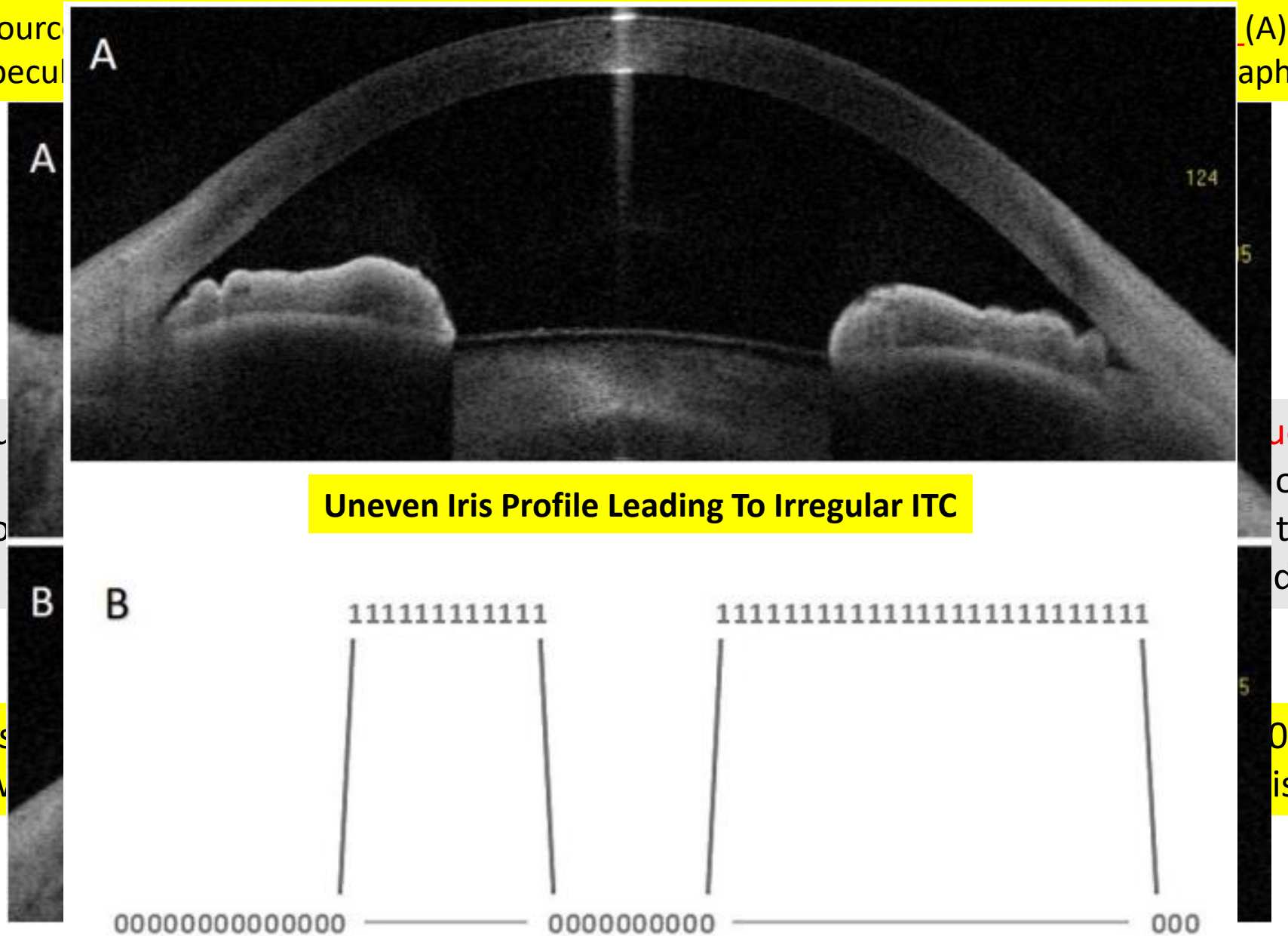
(SS-OCT) scan corresponding to a **steep iris profile** ('over-the-hill' configuration type) that was assessed as closed in gonioscopy but open in SS-OCT, representing a false negative or undercall case.

Development of a Score and Probability Estimate for Detecting Angle Closure Based on Anterior Segment Optical Coherence Tomography

MONISHA E. NONGPIUR, BENJAMIN A. HAALAND, SHAMIRA A. PERERA, DAVID S. FRIEDMAN, MINGGUANG HE, LISANDRO M. SAKATA, MANI BASKARAN, AND TIN AUNG



Swept-sourc (A) and
iridotrabecul aphy.



Uneven Iris Profile Leading To Irregular ITC

- Measu uenced by iris
- By inco to vary across

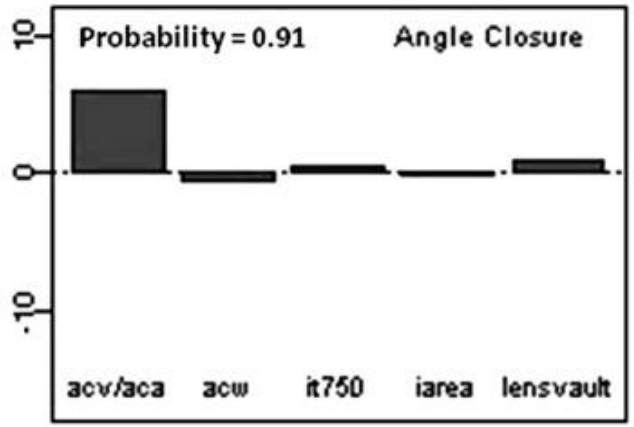
of eye.
dings

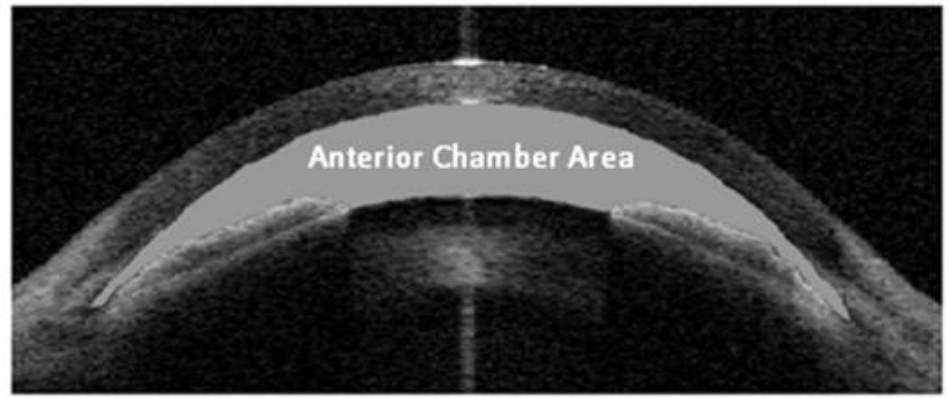
s 0.50.
At a low ises to 0.89.

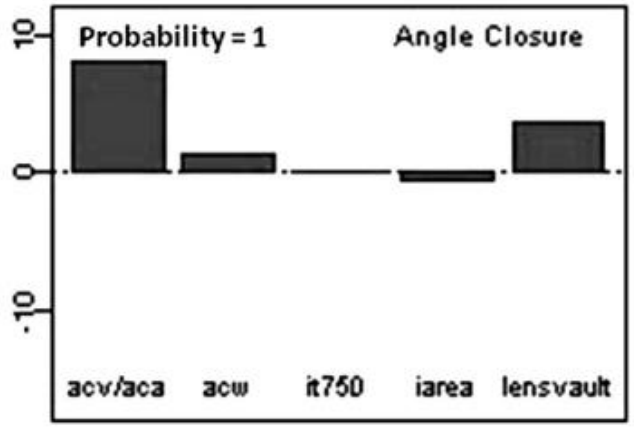
$$\text{Score} = -28.986879 - 0.339910 \times (\text{anterior chamber volume}) + 3.223506 \times (\text{anterior chamber width}) + 7.296654 \times (\text{iris thickness at } 750\mu\text{m}) - 2.202824 \times (\text{iris area}) + 1.534522 \times (\text{anterior chamber area}) + 0.003242 (\text{lens vault})$$

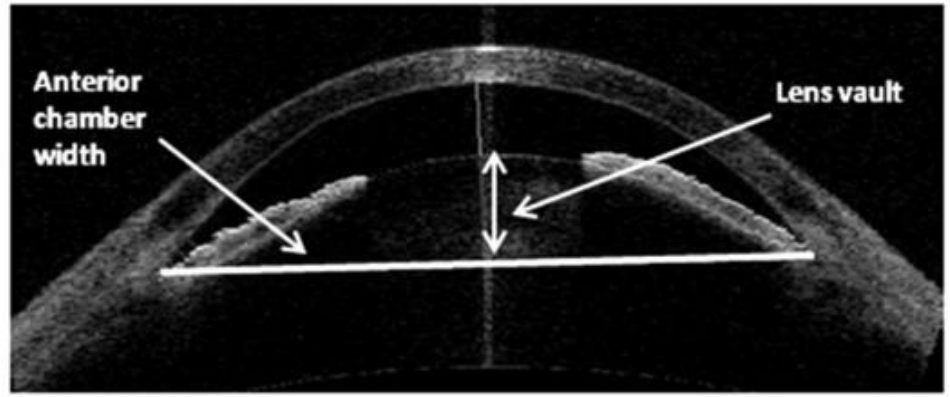
- Measurements of angle width such as TISA and AOD are relatively small and are influenced by iris contour;they therefore are subject to greater variation around circumference of eye.
- By incorporating nonangle parameters, the formula derived in this study is less likely to vary across meridional scans, and therefore more effectively summarizes the AS OCT findings

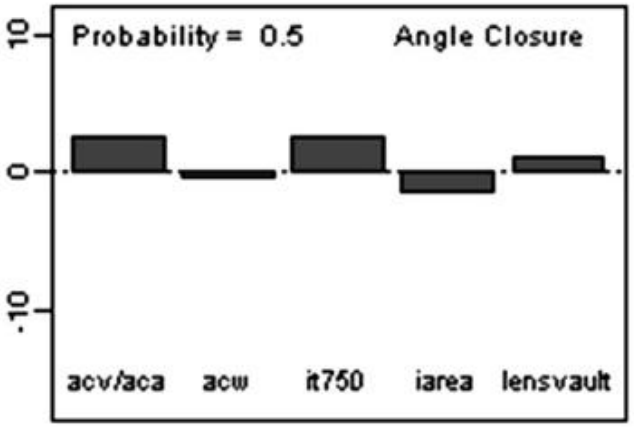
specificity of 0.96 and sensitivity of 0.75, the estimated probability threshold 0.50.
At a lower diagnostic threshold of 0.26, specificity drops to 0.89, whereas sensitivity rises to 0.89.

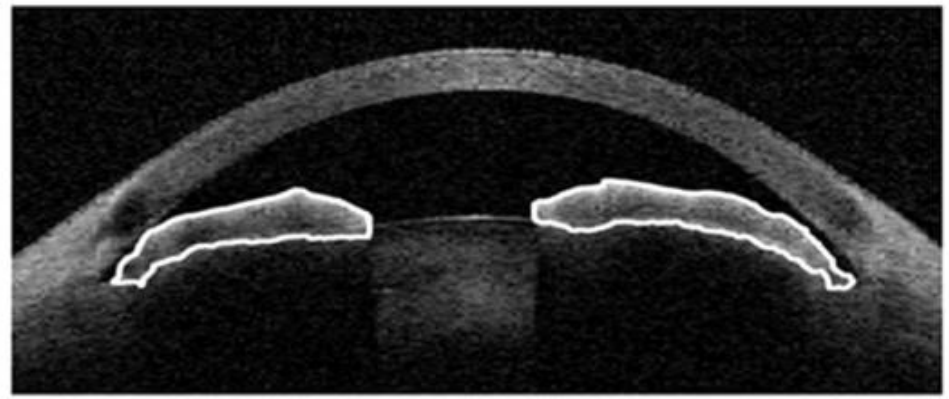

Probability = 0.91
Angle Closure
10
0
-10
acv/aca
acw
it750
iarea
lensvault

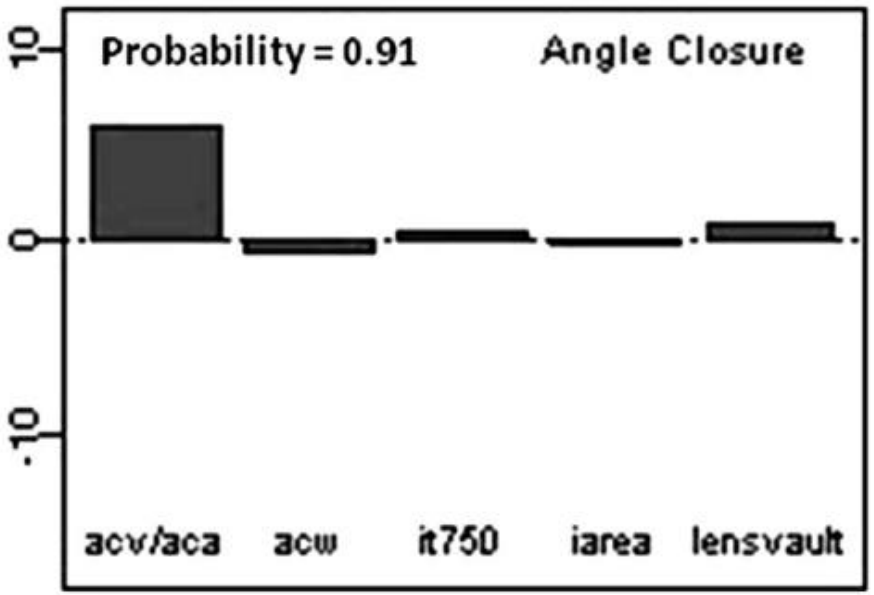

Anterior Chamber Area


Probability = 1
Angle Closure
10
0
-10
acv/aca
acw
it750
iarea
lensvault


Anterior chamber width
Lens vault


Probability = 0.5
Angle Closure
10
0
-10
acv/aca
acw
it750
iarea
lensvault




Probability = 0.91
Angle Closure
10
0
-10
acv/aca
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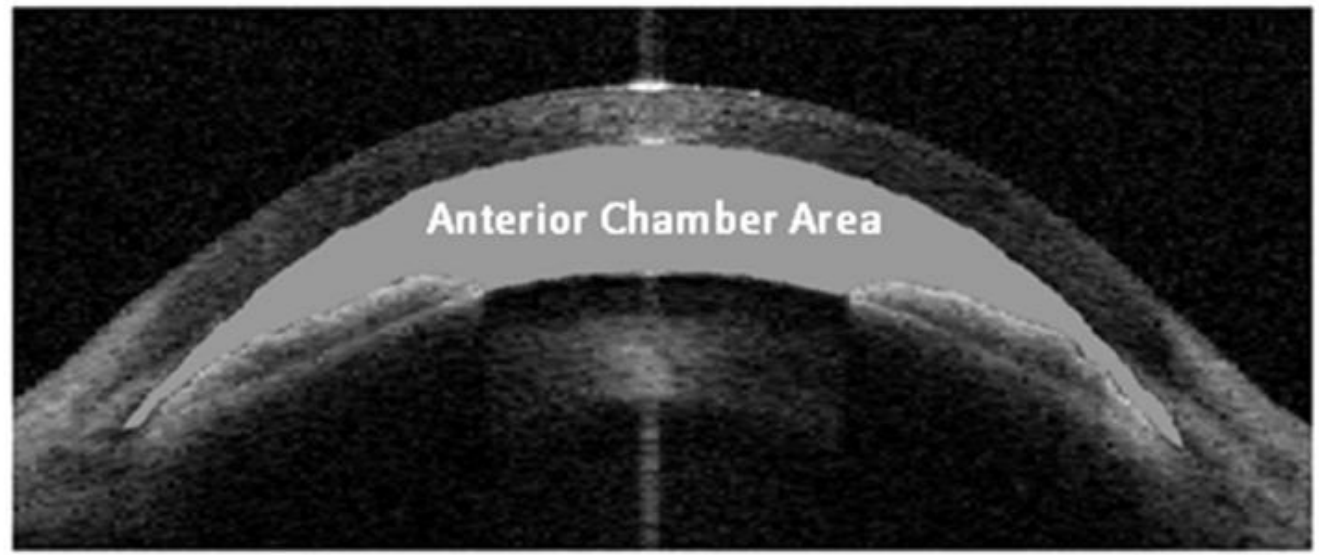
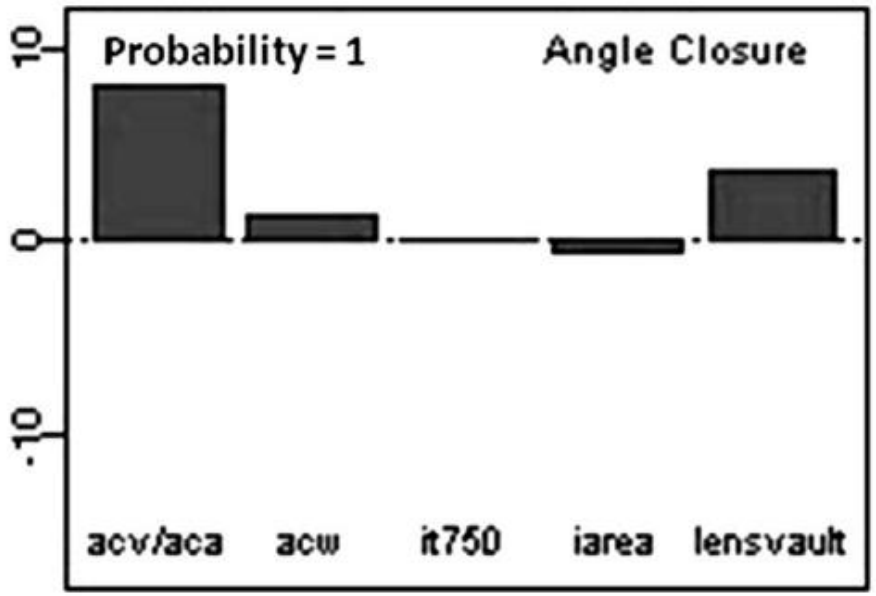
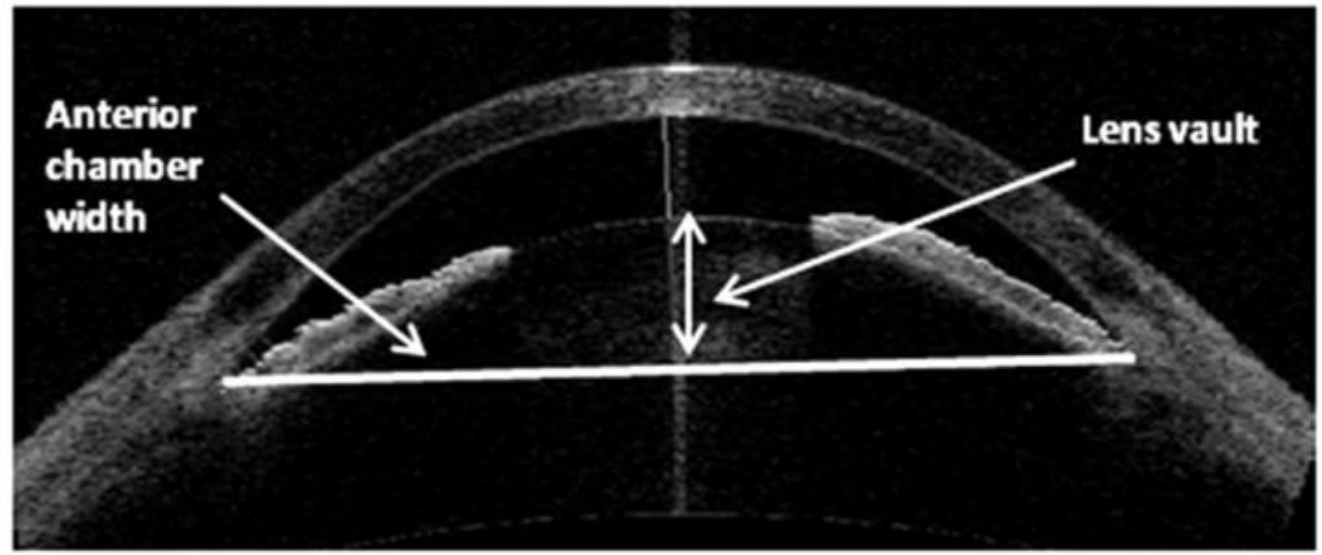
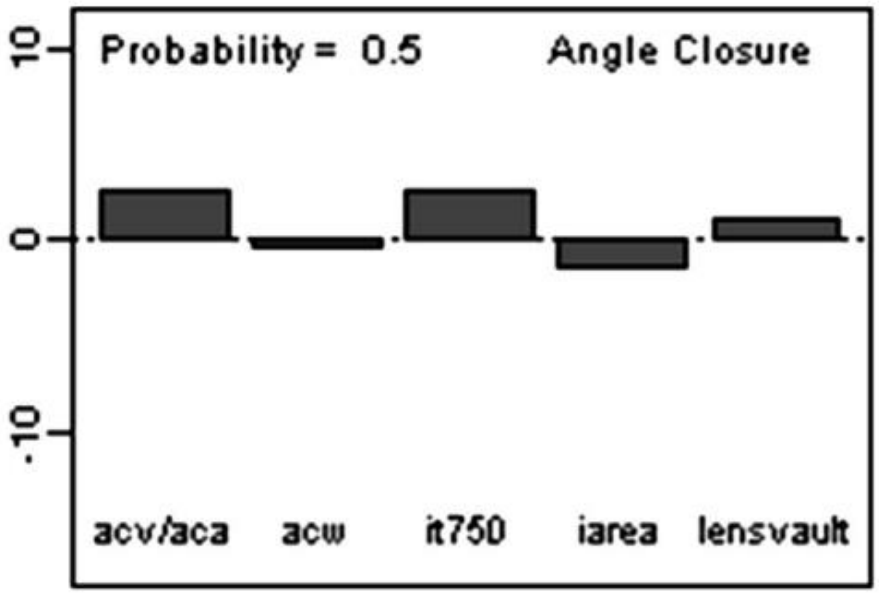
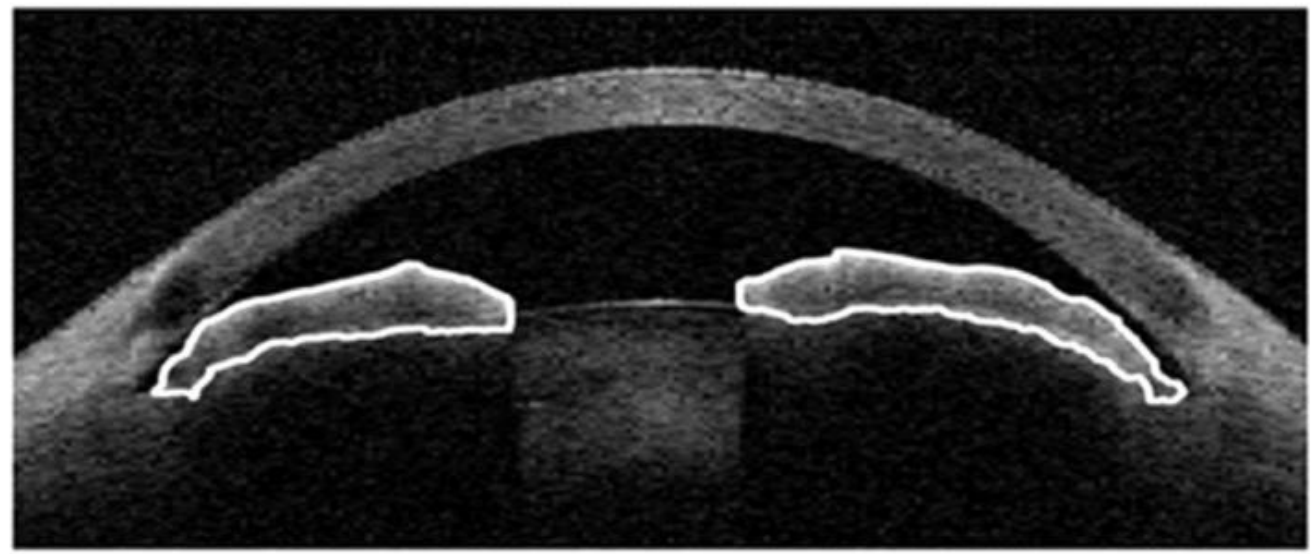
it750
iarea
lensvault


Anterior Chamber Area

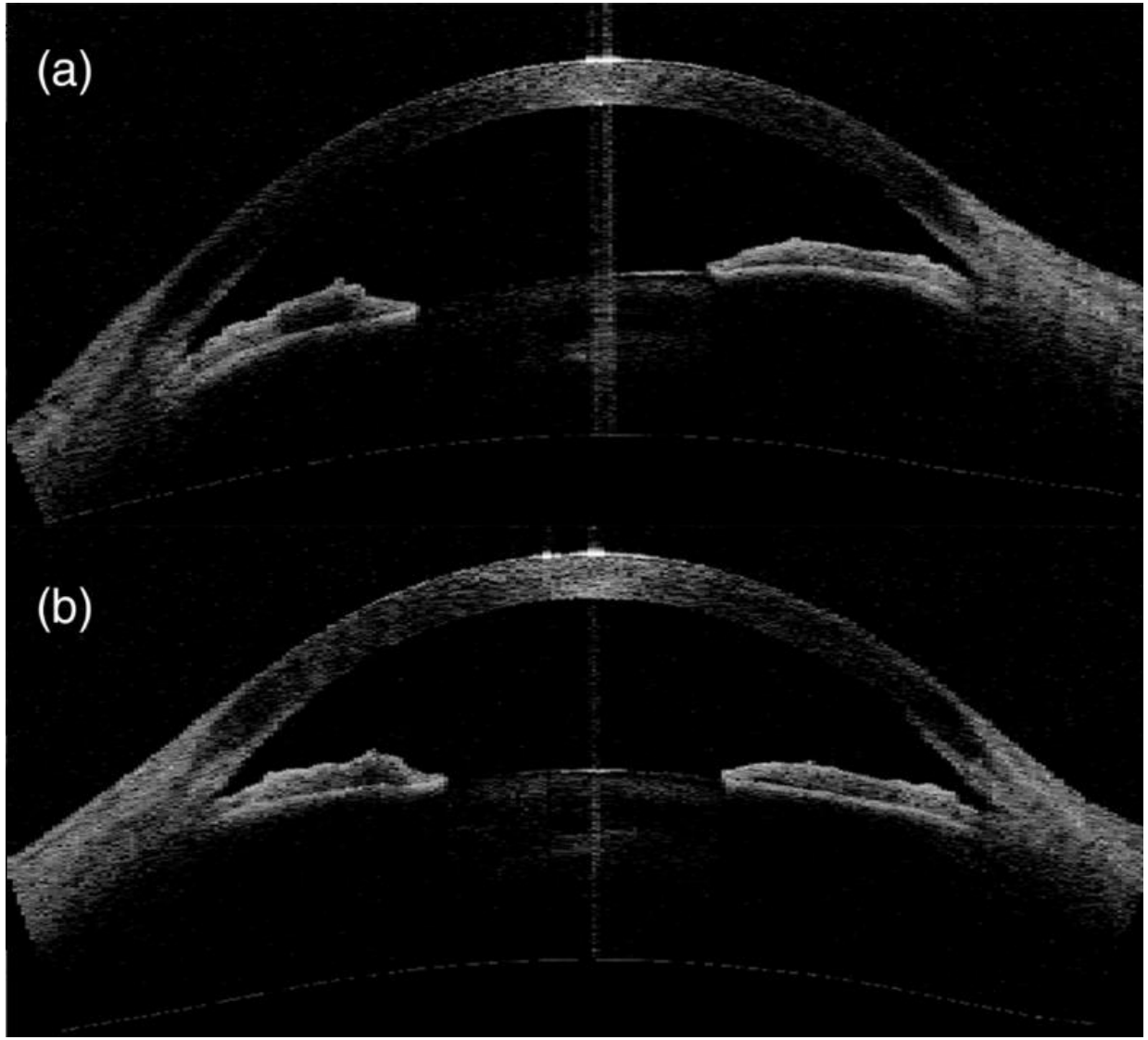

10
0
-10
Probability = 1
Angle Closure
acv/aca
acw
it750
iarea
lensvault


Anterior chamber width
Lens vault


Probability = 0.5
Angle Closure
10
0
-10
acv/aca
acw
it750
iarea
lensvault



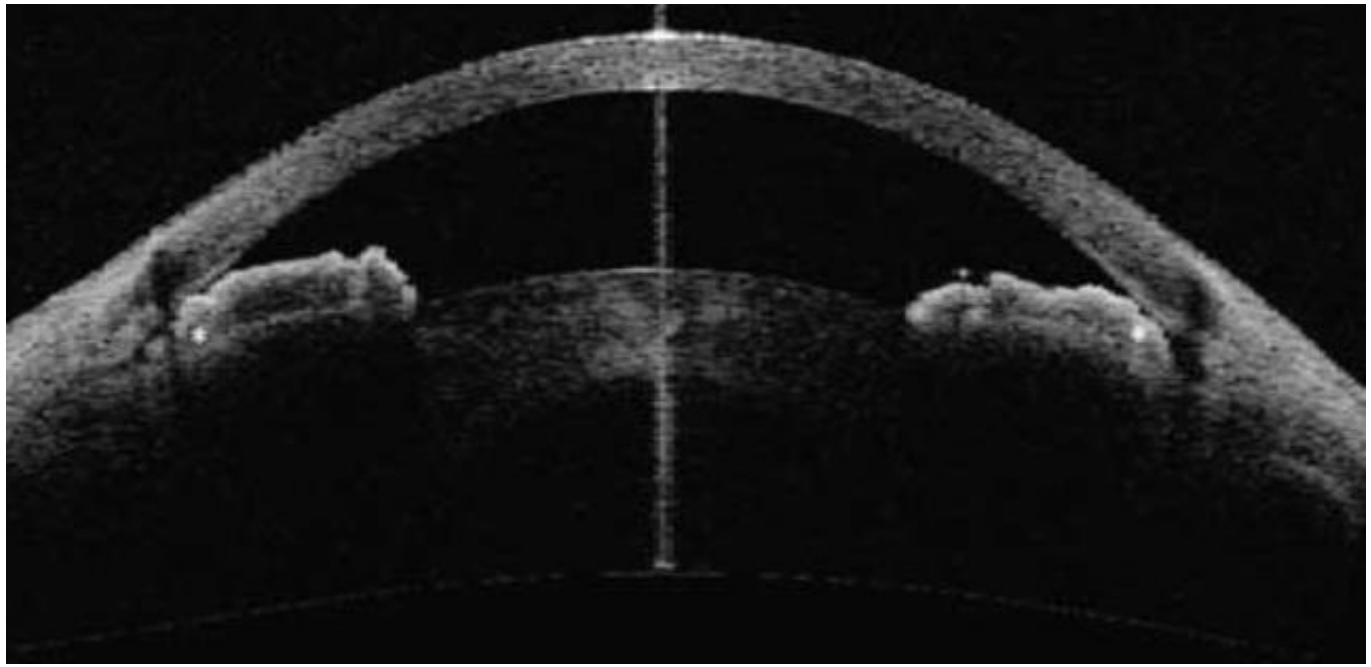
(a) pre- and (b) post-LPI
There is an increase in AOD 500 and a decrease in iris bowing



cautious monitoring for disease progression or intraocular pressure (IOP) elevation despite a patent LPI

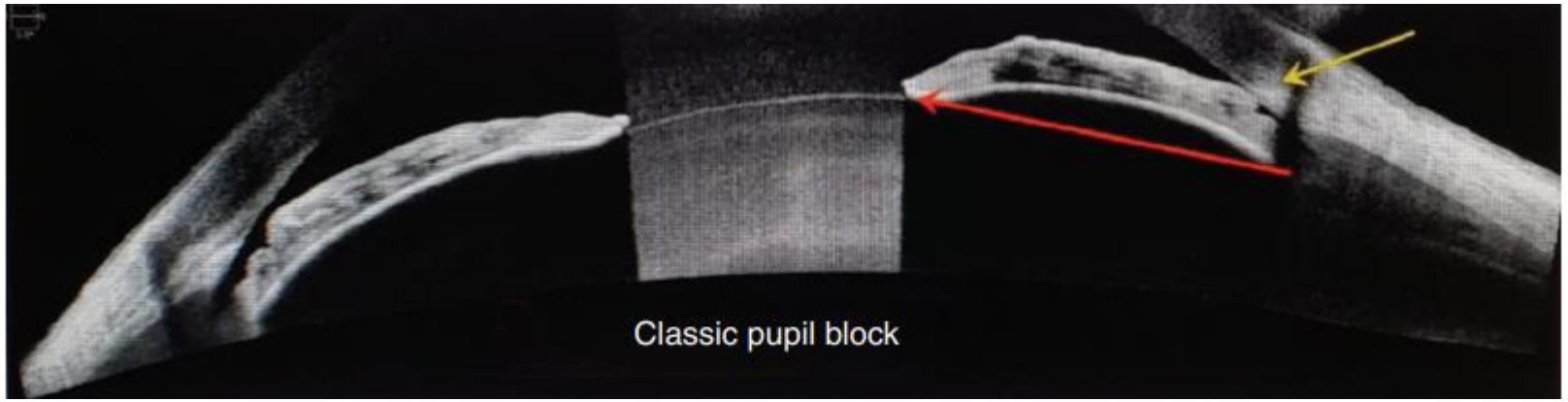
angle opening following LPI does not appear to be permanent; angle width narrowed over time, suggesting that nonpupil block mechanisms such as large LV may play a role.

eyes with thin peripheral iris and narrower angles were associated with greater angle opening following LPI, whereas eyes with thick peripheral iris at baseline showed less angle opening after LPI

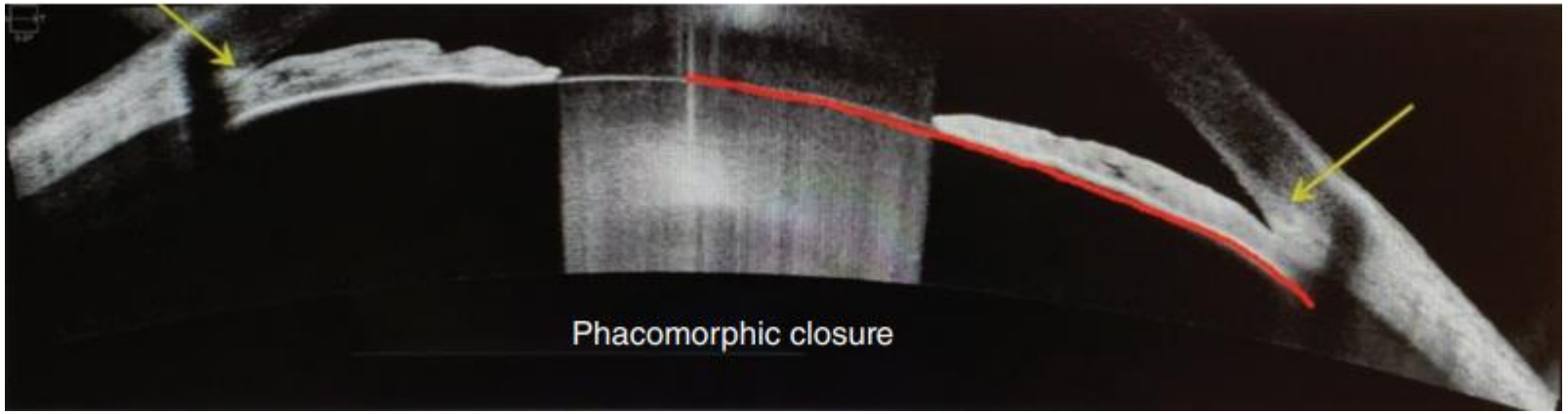


An ability to select angle closure eyes that would most likely benefit from LPI may aid in individualizing treatment and reduce unnecessary prophylactic LPI that may not be effective in opening the angles in some patients.

The distinction between classic pupil block narrow angle and phacomorphic narrow angle is often impossible to appreciate with gonioscopy but may be readily determined with AS-OCT.



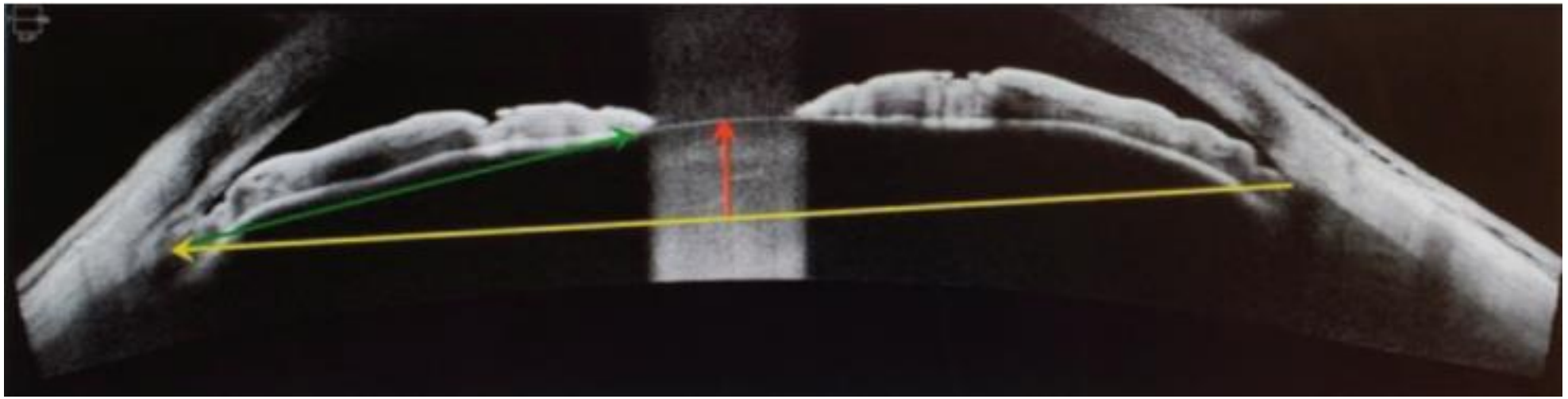
AS-OCT lens contour method for narrow angle, classic pupil block. AS-OCT image that demonstrates classic pupillary block



lens contour method for phacomorphic narrow angle. An AS-OCT image that demonstrates classic phacomorphic narrow angle

(EAGLE) study
CLE for
- Hypertensive PAC
- PACG

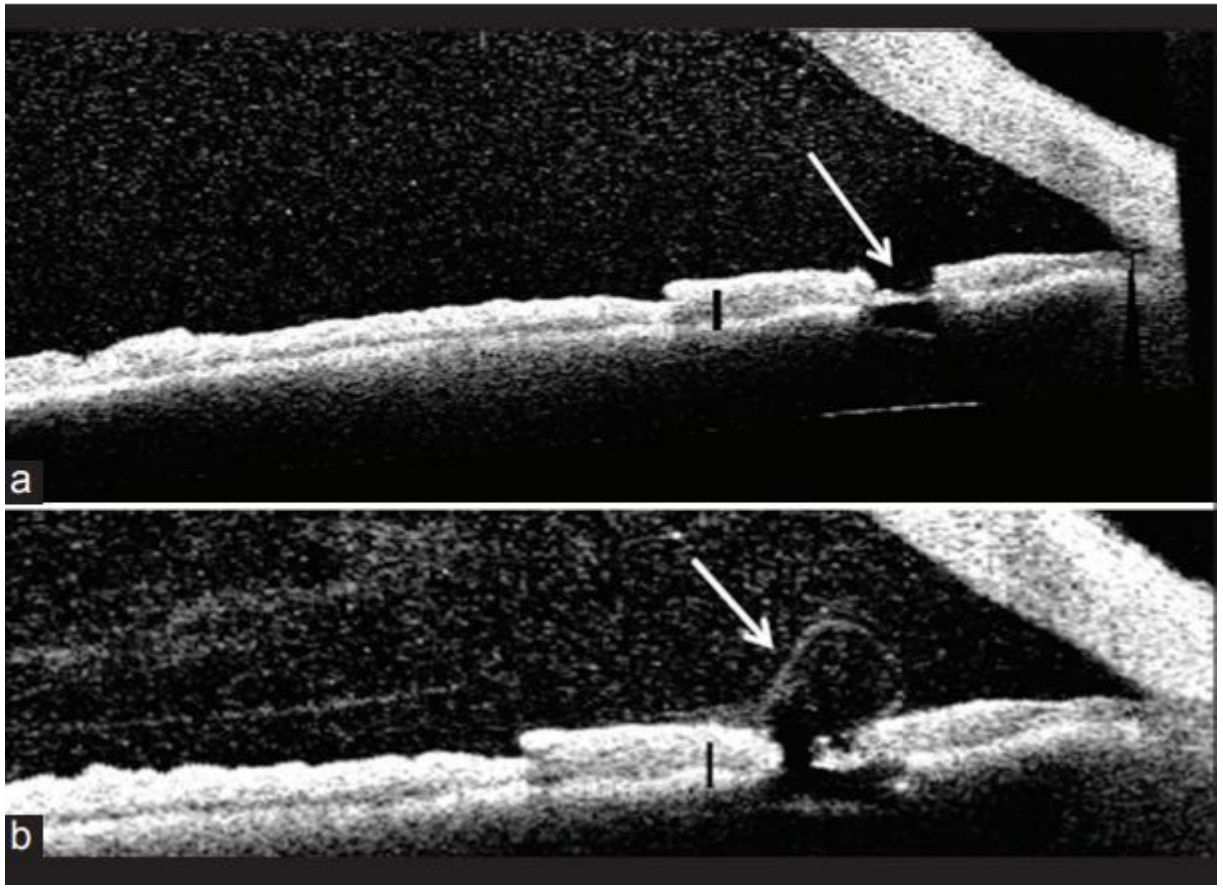
Mixed Pupil Block/Phacomorphic Condition



The decision for optimum treatment strategy would depend on several factors, including the visual **acuity, IOP, cataract severity, presence and extent of PAS**

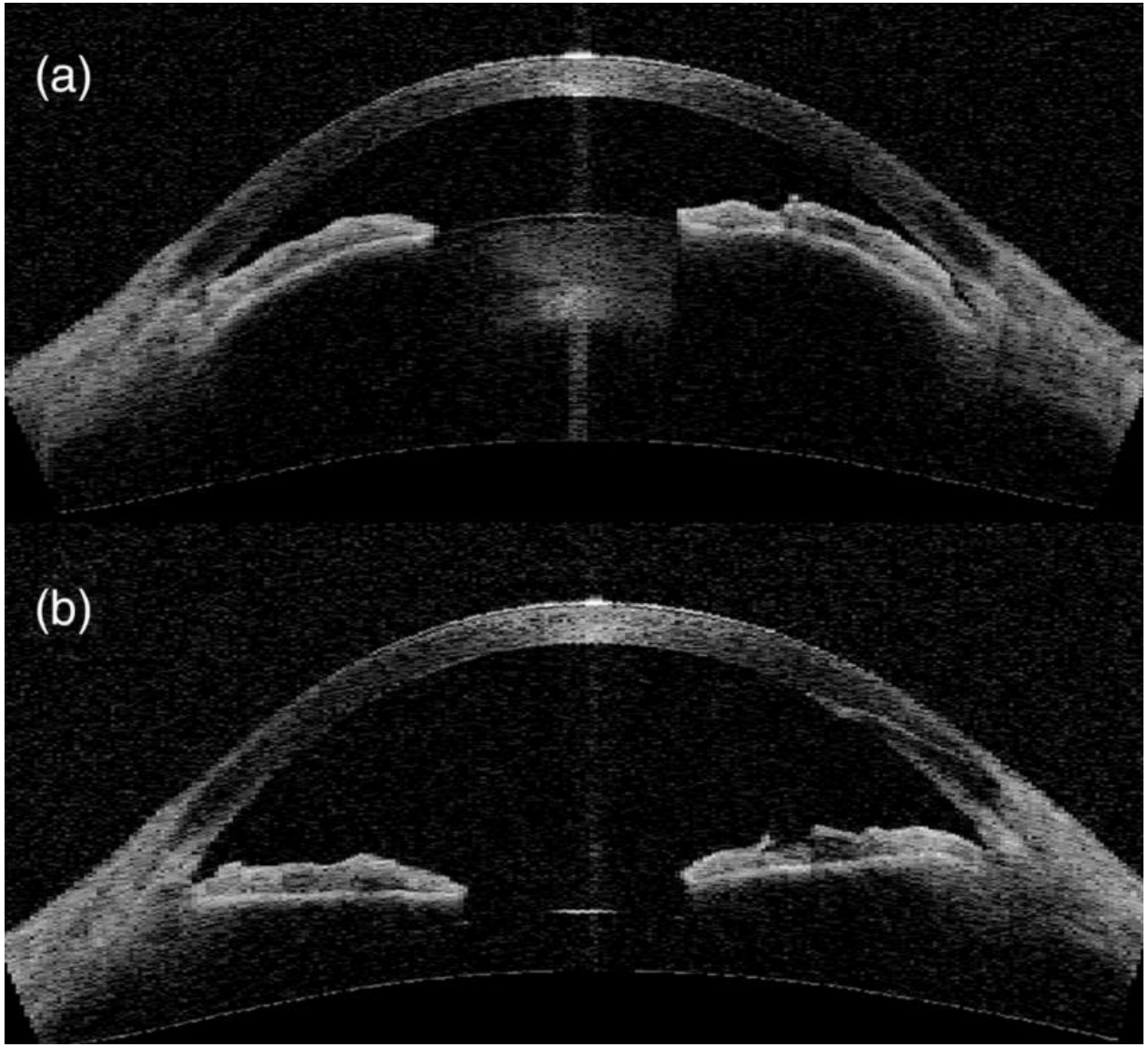
Regardless of choice, all forms of narrow angle require either laser or surgical intervention.

Topical therapies or observation may be harmfully insufficient in these eyes



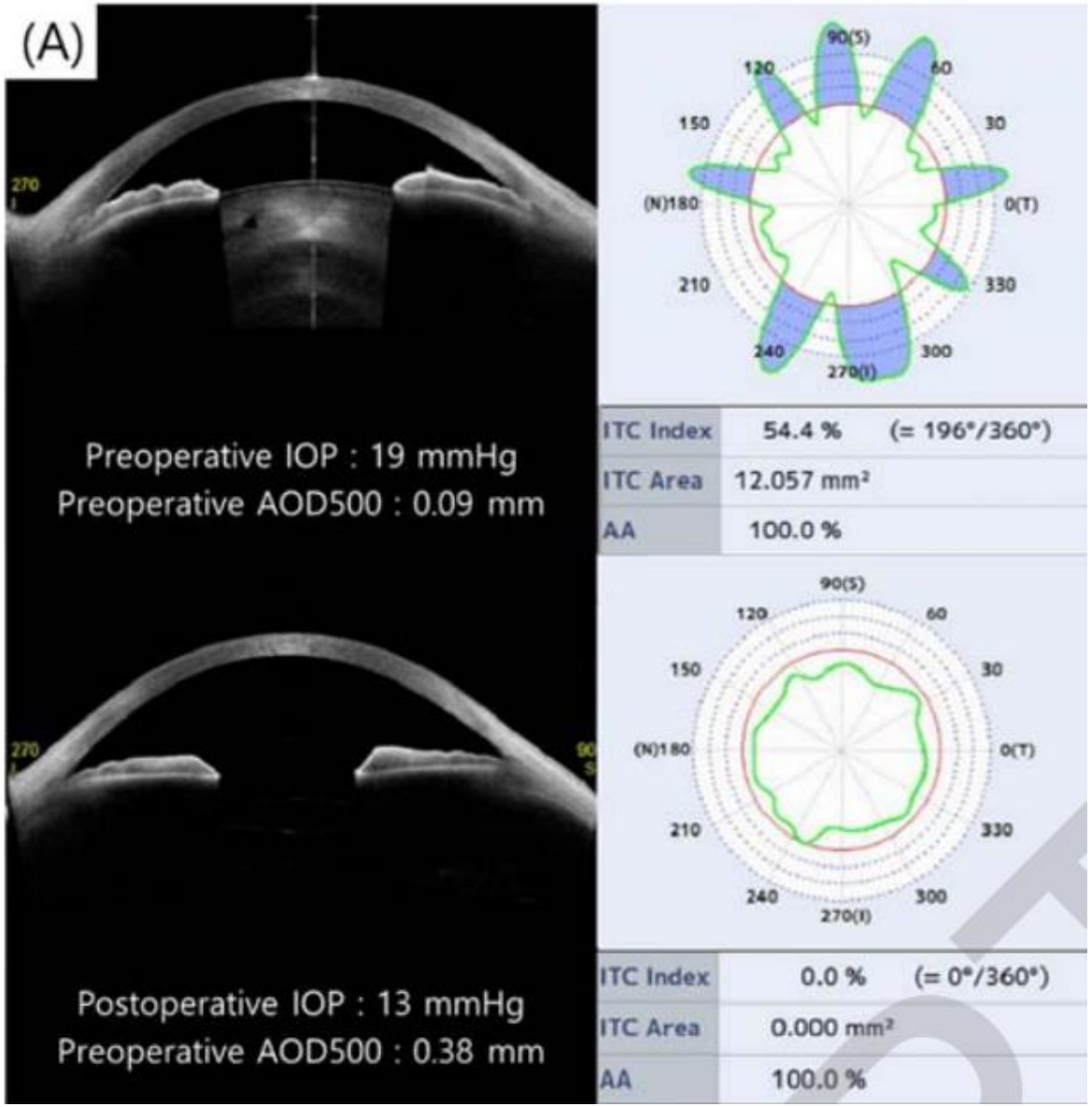
residual membrane occluding LI (arrow), though iris transillumination defect is apparent on slit-lamp (b) Following an additional (Nd: YAG),LI is patent

(a) pre- and (b) post-phaemulsification. There is an increase in AOD 500 and in ACD as well, while there is a decrease in iris bowing after phacoemulsification treatment.

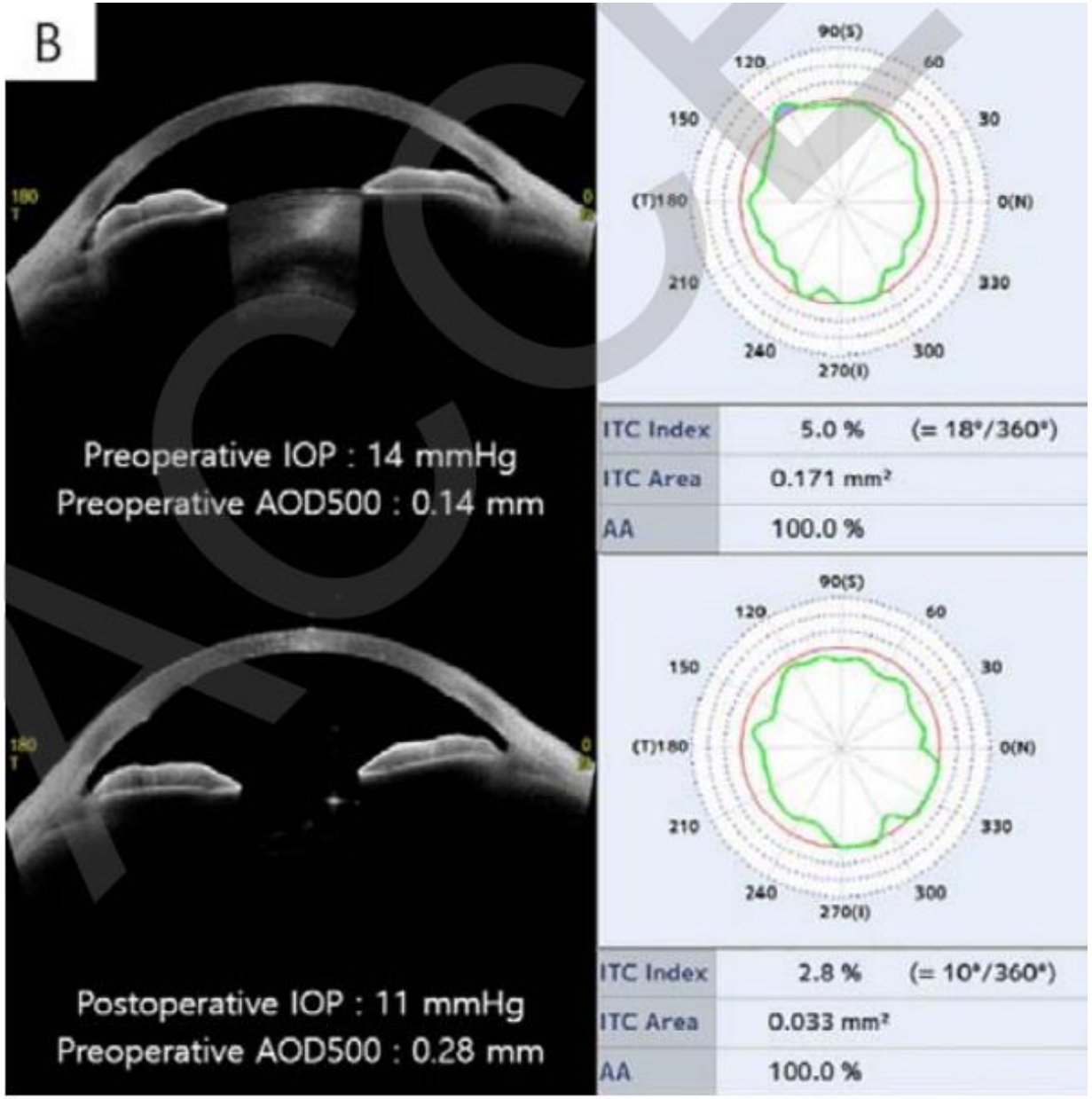


Anterior chamber angle and IOP control after PE in PACD with different mechanisms

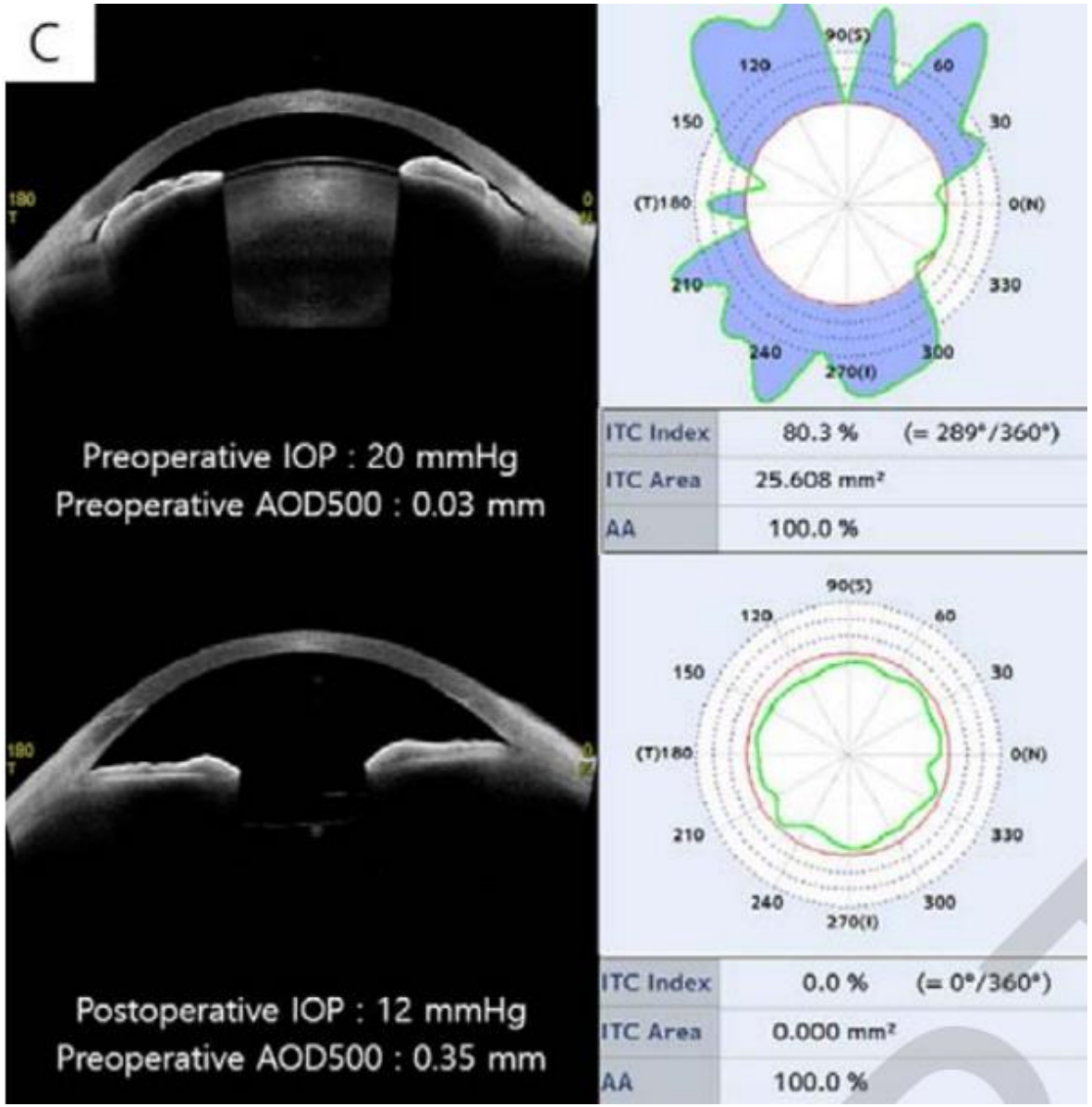
PB mechanism



PIC mechanism



High LV mechanism



As an adjunct to gonioscopy and evaluation of PAS

Mechanistic evaluation of PACD and treatment outcomes

As A predictor of development of angle closure and IOP fluctuation

As evidence for association between anterior segment features and angle closure grows, use of gonioscopy alone appears to be less and less inadequate for detecting subjects with angle closure disease.

It is arguable that anterior segment imaging should be considered first line screening for patients at risk for angle closure

AS-imaging as a potential ‘reference standard’ (but not replaced) for diagnosis and monitoring angle closure disease