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Comparison of Optical Coherence Tomography and Ultrasound Biomicroscopy for Detection of Narrow Anterior Chamber Angles

(Original Research Paper)

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ABSTRACT

OBJECTIVE: *To assess the accuracy of classification of ANTERIOR CHAMBER ANGLE by using ASOCT, UBM and GONIOSCOPY.*

MATERIAL AND METHOD: *We recruited 12 normal volunteers (24 eyes) and 18 subjects (36 eyes) with narrow angles Subjects with suspected narrow anterior chamber angle with or without elevated IOP. All subjects underwent OCT, UBM, and gonioscopy. AOD 500, TIA 500, TISA 500 were determined on AS OCT and UBM. The discriminative ability of OCT and UBM in identifying narrow angles was compared.*

RESULTS: *Sixty eyes of 30 subjects were included in the study. Thirty six eyes (60%) were classified on gonioscopy as having narrow angles. Mean values of the angle parameters measured by UBM and OCT were very similar. Repeatability as assessed by the pooled standard deviation of the repeated measures was not significantly different between the two imaging modalities. No significant difference was found between OCT and UBM parameters. The high level of efficiency in discriminating narrow angles is illustrated by the receiver operating characteristic curve of the TISA measured at 500 µm by OCT. The AUC of 0.861 (95% confidence interval, 0.679-1.00) shows that, based on the present sample, this parameter has good discriminative ability.*

CONCLUSION: *In this study, we have demonstrated a novel potential application for OCT at 830nm as an imaging modality for large-scale screening for PACG. The quantitative angle parameters as measured by OCT have similar mean values, reproducibility, and sensitivity-specificity profiles when compared with measurements obtained by UBM.*

KEY WORDS:- *Narrow angles, Gonioscopy, AS-OCT,UBM.*

INTRODUCTION

ACG is a worldwide problem to which attention should be paid with special regards to prevention and diagnosis.[1] Treating anatomically narrow angles with a laser periphery iridotomy may prevent development of angle closure. Therefore, early detection of anatomically narrow angles is important. Currently, gonioscopy is the clinical standard for assessing the risk of PACG. However, it is a subjective technique and there are no uniform gonioscopic criteria for identifying angles that require treatment. Cross-sectional imaging of the anterior chamber (AC) angle can provide quantitative data and may prove to be less subjective.[1] this study aims at finding the accuracy of classification of ANTERIOR CHAMBER ANGLE by using ASOCT, UBM and GONIOSCOPY.

MATERIAL AND METHOD

It was a prospective observational study. To obtain the complete range of AC angle width, we recruited 12 normal volunteers (24 eyes) from the OPD of MYH, normal Volunteers have negative family history of glaucoma ,IOP<=21mmhg, normal optic nerve head & VF & no h/o ocular & systemic disease and18 subjects (36 eyes) with suspected narrow angles. (Van Haricks) with or without elevated IOP. After obtaining informed consent, all of the subjects underwent OCT (SLO-OCT 830nm), UBM (OTI-35MHz probe) and gonioscopy. (Goldmann 3-mirror) OCT imaging was done prior to any contact procedure. Both OCT and UBM were performed under uniform conditions of dim illumination.

A narrow angle was defined as Shaffer grade 1 or lower in all quadrants.

The following anterior segment parameters were measured using ASOCT and UBM

1. Angle opening distance at 500 µm (AOD 500) [2-4]
2. Trabecular iris angle at 500 µm (TIA 500))[2-4]
3. Trabecular-iris space area at 500 µm (TISA 500)) [2-5]

Mean values of parameters measured by UBM and OCT were compared using the paired *t* test. The discriminative ability of the measured parameters in identifying narrow angles was determined by calculating sensitivity and specificity based on several alternative cut off values and by the area under the receiver operating characteristic curve (AUC).

RESULTS

Sixty eyes of 30 subjects were included in the study. Thirty six eyes (60%) were classified as having narrow angles.

Mean values of the angle parameters measured by UBM and OCT were very similar (**Table1**). However, small but statistically significant differences were observed in some parameters.

Table 1. Trabecula-iris angle, Angle opening distance,and Trabecular-iris space area Measured by Ultrasound Biomicroscopy and Optical coherence Tomography. (n=60 eyes)

Parameter	UBM,Mean(SD)	ASOCT,Mean(SD)	*P* Value
Nasal quadrant			
TIA 500µm	31.5(1.15)	24.5(1.11)	0.008
AOD 500µm	0.39(0.044)	0.42(0.043)	0.742
TISA500µm	0.16(.065)	0.18(.061)	0.880
Temporal quadrant			
TIA 500µm	33.5(1.18)	22.5(1.12)	0.007
AOD 500µm	0.44(0.054)	0.47(0.053)	0.016
TISA500µm	0.19(.070)	0.20(.071)	0.193

Repeatability as assessed by the pooled standard deviation of the repeated measures was not significantly different between the two imaging modalities.

Both OCT and UBM showed excellent discriminative value for the detection of narrow angles. (Table2)

Table 2. Accuracy of classification of Subjects with Occludable Angles (Gonioscopic Grade≤ 1) by Trabecula-iris angle, Angle opening distance, and Trabecular-iris space area. Each area measured at 500µm by Ultrasound Biomicroscopy and Optical coherence Tomography.

Parameter	Sensitivity %	Specificity %	Cutoff Value
TIA 500 µm			
UBM	72.2	41.7	18.4 degree
AS-OCT	94.4	41.7	17 degree
AOD 500µm			
UBM	66.7	58.3	299 µm
AS-OCT	94.4	41.7	252 µm
TISA500µm			
UBM	88.9	75.0	$0.121mm^2$
AS-OCT	94.4	83.3	$0.125mm^2$

Based on the AUC, the best OCT parameters for detecting narrow angles was the TISA 500 (AUC≥0.861). **(Table3)**

Parameter	AUC(95% Cl)
TIA 500µm	
UBM	0.412(0.136-0.688)
AS-OCT	0.417(0.138-0.696)
UBM	0.558(0.322-0.794)
AS-OCT	0.569(0.330-0.609)
UBM	0.815(0.605-1.0)
AS-OCT	0.861(0.679-1.0)

In OCT imaging, another advantage of the TISA is that identification of the scleral spur is more reliable than the angle recess. This is because the sclera spur is highly reflective and appears bright on the OCT image.

DISCUSSION

Li et al's (2007) showed that ASOCT could measure the anterior chamber angle with a high intra- and inter-session repeatability/ reproducibility in comparison with the modest UBM angle-measurement. However, Li et al chose only two angle parameters for their study: the angle opening distance and the trabecular-iris angle [6]. In our study we measured TISA in addition to TIA and AOD and found that our machine was also good in identifying eyes with narrow angles with high interobserver and intraobserver reprducibility.

Radhakrishnan et al. evaluated the reproducibility of anterior chamber (AC) angle measurements obtained using AS-OCT. All subjects underwent imaging of the nasal, temporal, and inferior AC angles with an AS-OCT. They determined the AC depth (ACD), AOD500, ARA500, TISA500. AC depth measurement demonstrated excellent reproducibility [7].

Narayanaswamy et al. assessed AS-OCT images for identifying eyes with narrow angles measuring AOD at 250, 500, and 750 µm from the scleral spur; TISA at 500 and 750 µm and ARA at 750 µm. They found AOD750 as the most useful angle measurement for identifying individuals with gonioscopic narrow angles in gradable AS-OCT images.

In our study we measured TIA500, AOD500, and TISA500 .We found TISA500 as the most useful angle measurement for identifying narrow angle in our study (Areas under the receiver operating characteristic curves for AS-OCT TISA500 was0.861) [8].

CONCLUSION

In this study, we have demonstrated a novel potential application for OCT at 830nm. Optical coherence tomography as an imaging modality has several characteristics that make it an excellent candidate for large-scale screening for PACG.

We have shown that the quantitative angle parameters as measured by OCT have similar mean values, reproducibility, and sensitivity-specificity profiles when compared with measurements obtained by UBM.

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