

# A COMPARISON OF ANTERIOR CHAMBER ANGLE ON GONIOSCOPY AND ON OPTICAL COHERENCE TOMOGRAPHY AND EVALUATION OF RETINAL NERVE FIBRE LAYER AND GANGLION CELL COMPLEX: A STUDY OF 50 CASES OF GLAUCOMA

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## ABSTRACT

**Background:** Gonioscopy is a traditional method of measurement of anterior chamber of eye and Optical Coherence Tomography (OCT) is newer method.

**Aims & Objective:** To compare the anterior chamber angle on gonioscopy & optical coherence tomography as well as evaluating the nerve fiber layer thickness & ganglion cell layer thickness in glaucoma patients.

**Material and Methods:** Fifty patients who had bilateral glaucoma under treatment were selected randomly for this study. They all had controlled IOP i.e. less than 21 mm of Hg by Schiottz Tonometry. Complete anterior segment evaluation done including lids, lashes, conjunctiva, sclera, cornea, anterior chamber, iris, pupil, lens and eye movements, Posterior segment evaluation included cup disc ratio, disc pallor, neuro retinal rim, haemorrhages on disc margin; Gonioscopy with Volk four mirror goniolens was performed and diagnosis of glaucoma confirmed. The closed angles were defined as non-visibility of posterior trabecular meshwork on gonioscopy; On OPTOVUE RTVue optical coherence tomography machine patient was examined for retinal nerve fiber layer and ganglion cell complex. Descriptive statistics was used and values were shown as mean and percentages.

**Results:** Angle closed in > / = 1 quadrants by was observed in 47.5% by gonioscopy and 70% by OCT. In all quadrants (superior, inferior, lateral and medial) closed angle was more in OCT as compared to gonioscopy. Average retinal fiber thickness in the case of primary open angle glaucoma was 89.86µm while in the case of primary closed angle glaucoma it was 77.12µm. Average ganglionic cell thickness in the case of primary open angle glaucoma was 94.16 and in the case of primary angle closure glaucoma it was 87.08. Average central corneal thickness in open angle glaucoma was 533.96 µm and closed angle glaucoma it was 535.25 µm.

**Conclusion:** Anterior segment OCT is a rapid noncontact method of imaging angle structures. Anterior segment OCT tended to detect more closed ACAs than gonioscopy, particularly in the superior and inferior quadrants.

**KEY-WORDS:** Gonioscopy; Optical Coherence Tomography (OCT); Anterior Chamber; Nerve Fibre Thickness

## Introduction

Glaucoma is a neurodegenerative disease of the optic nerve that presents to the practitioner at various stages of a continuum characterized by accelerated ganglion cell death, subsequent axonal loss and optic nerve damage and eventual visual field loss. It is the 2<sup>nd</sup> most common cause of blindness in world after cataract and a leading cause of irreversible blindness. 60 million people globally and 12 million people in India suffer silently from glaucoma of which 1.5 million people are blind. These numbers are expected to go up to 16 million by 2020 according to the 19<sup>th</sup> annual conference of Glaucoma Society of India.

Gonioscopy is an examination of the angle of anterior chamber by a special device called the gonioscope. It helps in revealing the formation of goniosynechiae, inflammatory deposits, membrane formation, pigment deposits, neovascularization, foreign bodies & tumour cells and can also help to measure the angle width. The traditional method and reference diagnostic standard for angle assessment is visualization of angle structures by indirect Gonioscopy. However there are certain limitations.<sup>[1]</sup> Another method is Optical Coherence Tomography (OCT) which is a novel, three dimensional, non-contact imaging technology that allows detailed cross-sectional imaging (tomography) of the eye. In the last one

decade, OCT has become one of the most common applied imaging technologies for retinal conditions.<sup>[2,3]</sup> However, it is only recently that the OCT technology has been adapted for similar imaging of the anterior segment. Ophthalmic OCT was initially developed for posterior segment imaging and used 830nm wavelength super luminescent diode (SLD) light source.<sup>[4,5]</sup> The Anterior Segment OCT uses longer wavelength (1310 nm), thus allowing cross-sectional imaging and detailed visualization of the anterior chamber angle. A scan speed which is 40 times faster than previous OCT systems allows real time imaging to be performed.

The study was performed with the aim of comparing the anterior chamber angle on gonioscopy & optical coherence tomography as well as evaluating the nerve fiber layer thickness & ganglion cell layer thickness in glaucoma patients.

## Materials and Methods

This study was carried out on patients admitted in Ophthalmology Ward and Out Patient Department at Sir Sayajirao General Hospital, Baroda, studied over period of January 2008 to December 2009.

Fifty patients who had bilateral glaucoma under treatment were selected randomly for this study. 30 patients were of open angle glaucoma and 20 patients were of angle closure glaucoma. They all had controlled IOP i.e. less than 21 mm of Hg by Schiötz Tonometry. Only those patients whose age was within 20 to 80 year range were included. Patients having IOP more than 21 mm of Hg, having any ocular media opacity (Corneal opacity, Mature/hyper mature cataracts, Vitreous hemorrhage), suffering from post-traumatic glaucoma or uniocular glaucoma were not included in the study. Optical coherence tomography was carried out at Govind Clinic, Baroda under guidance of Dr. Madhvi Seth.

The patients were examined in OPD 12 from 9:00 am to 1:00 pm at SSG Hospital, Baroda. Screening of patients was done on outpatient basis and a detailed history was taken. Complaints of ocular pain, redness of eyes, dimness of vision, decreased field of and/or scotomas were noted. Past history

regarding similar episodes and the frequency and periodicity thereof were also noted. Family history regarding glaucoma was elicited and noted. A brief treatment history regarding type of treatment and duration of treatment was asked. The ocular examination included: Best corrected vision in both eyes; Intra ocular pressure measurement by Schiötz tonometer; Complete anterior segment evaluation done including lids, lashes, conjunctiva, sclera, cornea, anterior chamber, iris, pupil, lens and eye movements, Posterior segment evaluation included cup disc ratio, disc pallor, neuro retinal rim, hemorrhages on disc margin; Gonioscopy with Volk four mirror gonioscope was performed and diagnosis of glaucoma confirmed. The closed angles were defined as non-visibility of posterior trabecular meshwork on gonioscopy; On OPTOVUE RTVue optical coherence tomography machine patient was examined for retinal nerve fiber layer and ganglion cell complex; On OPTOVUE RTVue optical coherence tomography machine patient was examined for central corneal thickness and anterior chamber angle after installing CAM-L attachment. Angles were diagnosed as closed on ASOCT is any contact between peripheral iris and angle wall anterior to scleral spur and calculation of all optical coherence tomography data was done and noted.

## Results

Total 50 patients were studied out of which 31 (62%) were males and 19 (38%) were females. Patients having age within 20-80 were included. Majority of patients (64%) were having age between 51-70 years. Results of anterior segment measurements are given in table 1.

**Table-1: Anterior Segment Measurement by Gonioscopy and OCT**

Angle Closed in $\geq 1$ Quadrants by	Percentage of Eyes
Gonioscopy	47.5%
AS - OCT	70 %

**Table-2: Rates of Closed Angles on Gonioscopy as Compared with OCT**

Angle Closure in Quadrants	Gonioscopy	AS - OCT
superior	30%	50%
inferior	22.5%	47.5%
lateral	22.5%	15%
medial	15%	20 %

**Table-3: Age wise Distribution of Retinal Fiber Thickness in Right Eye (RE) and Left Eye (LE)**

Age in Years	RE	LE
20 - 30	103.44 $\mu\text{m}$	93.93 $\mu\text{m}$
31 - 40	103.81 $\mu\text{m}$	98.90 $\mu\text{m}$
41 - 50	73.40 $\mu\text{m}$	85.14 $\mu\text{m}$
51 - 60	84.67 $\mu\text{m}$	84.28 $\mu\text{m}$
61 - 70	78.31 $\mu\text{m}$	81.95 $\mu\text{m}$
71 - 80	63.33 $\mu\text{m}$	71.26 $\mu\text{m}$
Average NFLT	85.14 $\mu\text{m}$	

**Table-4: Age wise Distribution of Ganglionic Cell Complex Thickness in Right Eye (RE) and Left Eye (LE)**

Age in Years	RE	LE
20 - 30	102.18 $\mu\text{m}$	93.64 $\mu\text{m}$
31 - 40	98.33 $\mu\text{m}$	96.54 $\mu\text{m}$
41 - 50	83.55 $\mu\text{m}$	86.71 $\mu\text{m}$
51 - 60	95.23 $\mu\text{m}$	89.21 $\mu\text{m}$
61 - 70	88.68 $\mu\text{m}$	97.39 $\mu\text{m}$
71 - 80	64.78 $\mu\text{m}$	75.54 $\mu\text{m}$
Average GCC	81.25 $\mu\text{m}$	

**Table-5: Central Corneal Thickness Measurements in Open Angle Glaucoma and Closed Angle Glaucoma**

	RE	LE	Average
Open Angle Glaucoma	535.66 $\mu\text{m}$	532.26 $\mu\text{m}$	533.96 $\mu\text{m}$
Angle Closure Glaucoma	537.45 $\mu\text{m}$	533.05 $\mu\text{m}$	535.25 $\mu\text{m}$

Average retinal fiber thickness in the case of primary open angle glaucoma was 89.86  $\mu\text{m}$  while in the case of primary closed angle glaucoma it was 77.12  $\mu\text{m}$  [Table 3]. Average ganglionic cell thickness in the case of primary open angle glaucoma was 94.16 and in the case of primary angle closure glaucoma it was 87.08 [Table 4]. Measurements of central corneal thickness are given in table 5.

## Discussion

Though the traditional method and reference diagnostic standard for angle assessment is visualization of angle structures by indirect Gonioscopy, ASOCT is a noncontact technique and ASOCT uses infrared light and thus the angle can be viewed in its natural state.

When we examined patients of angle closure glaucoma with gonioscopy and AS OCT it was observed that Anterior Segment OCT is a rapid noncontact method of imaging angle structures. AS OCT is highly sensitive in detecting angle closure when compared with gonioscopy as more persons are found to have closed angles with AS-OCT than with gonioscopy. These findings confirm the earlier work of Nolan and colleagues who

found AS OCT is highly sensitive in detecting angle closure when compared with gonioscopy.<sup>[6]</sup> Sakata LM et al also compared gonioscopy and AS - OCT and concluded Anterior segment OCT tended to detect more closed ACAs than gonioscopy.<sup>[7]</sup>

Thinner CCT in patients with glaucoma may result in underestimation of IOP, whereas thicker corneas may lead to an overestimation of IOP in subjects with OH. By determining CCT with OCT, a new and precise technique to measure CCT, this study emphasizes the need for a combined measurement of IOP and CCT in order to obtain exact IOP readings. Although the 2 anterior segment OCT imaging systems have similar design and working principles, clinicians should be aware of the differences in CCT measurement between the 2 anterior segment OCTs.

We examined Central Corneal Thickness of 50 glaucomatous patients and the average CCT in both angle closure glaucoma and open angle glaucoma was less than 555  $\mu\text{m}$ . Similar findings were also observed in study done by Bechmann M et al.<sup>[8]</sup> Ocular hypertension treatment study (OHTS) also showed CCT to be powerful predictor of development of glaucoma. Eyes with CCT of 555  $\mu\text{m}$  or less has three fold greater risk of development of glaucoma than eyes with CCT more than 588  $\mu\text{m}$

Glaucoma often causes focal regions of retinal nerve fiber layer (RNFL) loss. These areas of RNFL thinning can be difficult to detect by the traditional methods of ophthalmoscopes, stereoscopic biomicroscopy and optic nerve head photography, or evaluation of the red free NFL reflex. The ability of OCT to profile the NFL in cross-section with high resolution is useful in the identification of focal or diffuse areas of NFL thinning.

In this study of 50 patients with glaucomatous eyes studied for Retinal Nerve Fiber Layer Thickness and concluded that OCT can quantitatively measure RNFL thickness and GCC thickness in glaucomatous patients. The nerve fibre layer thicknesses and ganglion cell layer thickness significantly decrease with age &

quantitative differences in RNFL thickness exist between age-matched normal and glaucomatous.

LIU Xing, LING Yunlan, LUO Rongjiang, GE Jian, ZHENG Xiaoping studied to investigate image characteristics and thickness of the retinal nerve fiber layer (RNFL) in normal and glaucomatous eyes using optical coherence tomography (OCT) and concluded that OCT can quantitatively measure RNFL thickness differences between normal persons and glaucomatous patients, these findings confirm the present study.

## Conclusion

Anterior segment OCT is a rapid noncontact method of imaging angle structures. Though the gonioscopy is a traditional method and reference diagnostic standard for angle assessment, AS OCT is highly sensitive in detecting angle closure when compared with gonioscopy. The highest rates of closed angles on gonioscopy and AS OCT images were observed in the superior quadrant. Anterior segment OCT tended to detect more closed ACAs than gonioscopy, particularly in the superior and inferior quadrants. More persons are found to have closed angles with AS-OCT than with gonioscopy. CCT is a powerful predictor of development of glaucoma. The nerve fibre layer thickness significantly decreases with age & quantitative differences in RNFL thickness exist between age-matched normal and glaucomatous eyes. The ganglion cell layer thickness significantly decreases with age & quantitative

differences in RNFL thickness exist between age-matched normal and glaucomatous eyes.

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