

## Comparative study of ocular biometry in primary angle closure suspect, primary angle closure glaucoma and normal subjects

Ramakrishna Swati<sup>1\*</sup>, Reddy Shivaprasad<sup>2</sup>

<sup>1</sup>Resident, <sup>2</sup>Professor, Dept. of Glaucoma, Minto Ophthalmic Hospital, Bangalore

\*Corresponding Author

E-mail: swatiprakash.darpan@gmail.com

### Abstract

**Background:** Biometric studies of the ocular dimensions in eyes with narrow anterior chamber angles provide insight into the pathophysiology of pupillary block and may show which eyes are more prone to develop angle closure glaucoma. Aim of this study was to compare ocular biometric values in eyes of patients with primary angle closure suspect, primary angle closure glaucoma and normal subjects.

**Methods and Material:** In this hospital based observational study, 40 cases of primary angle closure suspect and 40 cases of primary angle closure glaucoma and 40 normal subjects were included.

The study subjects satisfying inclusion criteria, were underwent for ultrasonic A scan biometry, Keratometric readings (K1, K2), axial length (AXL), anterior chamber depth (ACD) and lens thickness (LT) measurement. Lens/axial length factor (LAF) as the lens thickness to axial length ratio multiplied by 10 was calculated. Relative lens position (RLP) as the relative position of the centre of the lens determined by adding the anterior chamber depth to half the lens thickness and then dividing the sum by axial length and multiplied by 10 was calculated.

**Statistical analysis used:** One way analyses of variance (ANOVA) and Chi square test were used. P value of less than 0.05 was accepted as indicating statistical significance. Data analysis was carried out using Statistical Package for Social Science (SPSS, V 10.5).

**Results:** Mean values of K1 were 44.74D, 43.99D, 43.99D and mean values of K2 were 45.01D, 44.04D, 44.42D among PACG, primary angle closure suspect and Normal group respectively.

Mean values of AXL were 22.39mm, 23.07mm and 23.16mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values of ACD were 2.42mm, 2.74mm and 3.19mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values of LT were 4.77mm, 4.32mm and 3.96mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values of LAF were 2.13, 1.88 and 1.71 among PACG, primary angle closure suspect and Normal group respectively.

Mean values of RLP were 2.14, 2.12 and 2.23 among PACG, primary angle closure suspect and Normal group respectively.

**Conclusions:** Our findings regarding AXL, ACD, LT, LAF and RLP show a significant progressive shift in biometric characteristics from normal eyes to eyes with primary angle closure suspect and then to eyes with PACG.

**Key words:** Ocular biometry, Primary angle closure suspect, Primary angle closure glaucoma, Ultrasonic A scan.

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### Introduction

Glaucoma is fast emerging as a major cause of blindness in India.<sup>[1]</sup> It has been estimated that prevalence of primary open angle glaucoma to primary angle closure glaucoma in India is 1:1.<sup>[2]</sup> Angle closure glaucoma is more common in India than in the West, the reasons for which are not clearly understood.<sup>[1]</sup>

Biometric studies of the ocular dimensions in eyes with narrow anterior chamber angles provide insight into the pathophysiology of pupillary block and may

show which eyes are more prone to develop angle closure glaucoma.<sup>[3]</sup>

It has been a general clinical impression that Asian Indians eyes have shorter axial lengths than Western eyes. However, there are a few population based data available from India.<sup>[2]</sup> Hence this study intends to report biometric data of Indian subjects with primary angle closure suspect and primary angle closure glaucoma.

### Subjects and Methods

This was a hospital based observational study.

**Sample size:** 40 cases of primary angle closure suspect and 40 cases of primary angle closure glaucoma and 40 normal subjects.

**Source of data:** Patients attending outpatient department or admitted in Minto Ophthalmic Hospital, Bangalore.

**Inclusion Criteria:**

1. Adults aged more than 30 years
2. **According to ISGEO classification of Primary angle closure glaucoma. Primary angle closure suspect:** An eye in which appositional contact between the peripheral iris and posterior trabecular meshwork is considered possible; angle in which  $\geq 270^\circ$  of the posterior trabecular meshwork (the part which is often pigmented) cannot be seen
3. **Primary angle closure glaucoma:** An eye with an occludable drainage angle and features indicating that trabecular obstruction by the peripheral iris has occurred, such as peripheral anterior synechiae, elevated intraocular pressure, iris whorling (distortion of the radially orientated iris fibres), "glaucoma-fleken" lens opacities, or excessive pigment deposition on the trabecular surface with optic disc changes and visual field defects of glaucoma
4. **Normal subjects:** Normal ocular examination with no evidence of glaucoma, no refractive error.
  - a. Intra-ocular pressure of less than 22 mm of Hg
  - b. Open angle on gonioscopy
  - c. No history of intraocular surgery

**Exclusion Criteria:**

1. Secondary angle closure glaucoma like lens intumescence, subluxation, trauma, iris neovascularization

If both eyes of a subject are eligible, one eye was randomly selected for analysis. After taking informed consent, evaluation of all patients was carried out in which detailed history was taken followed by detailed ocular examination including visual acuity, slit lamp biomicroscopy, IOP measurement, gonioscopy and funduscopy were done.

For the subjects satisfying inclusion criteria, biometry was performed before the use of any mydriatic or pilocarpine.

Ultrasonic A-scan biometry was done with Optikan 2000, Italy (Propagation speed:- Anterior chamber and vitreous 1532 m/s and lens 1641 m/s). Keratometric readings, axial length, anterior chamber depth, lens thickness were measured.

Lens/axial length factor as the lens thickness to axial length ratio multiplied by 10 was calculated. Relative lens position as the relative position of the centre of the lens determined by adding the anterior chamber depth to half the lens thickness and then dividing the sum by axial length and multiplied by 10 was calculated.

**Statistical analysis used:** One way analyses of variance (ANOVA) and Chi square test were used. p value of less than 0.05 was accepted as indicating statistical significance. Data analysis was carried out

using Statistical Package for Social Science (SPSS, V 10.5).

**Results**

Mean age of patients with primary angle closure glaucoma was 62.52yrs, whereas of primary angle closure suspect group was 52.35yrs and in normal group it was 47.78yrs. Maximum PACG patients were in 70-79yr age group whereas in primary angle closure suspect and normal group, maximum patients were in 50-59year age group.

Gender ratio (male: female) was 40:60 in PACG and normal group, 60:40 in primary angle closure suspect group.

Mean values of IOP were  $33.6 \pm 9.6$ mmHg,  $18.55 \pm 4.2$ mmHg and  $14.1 \pm 2.8$ mmHg among PACG, primary angle closure suspect and Normal group respectively

Mean values of K1 were 44.74D, 43.99D, 43.99D and mean values of K2 were 45.01D, 44.04D, 44.42D among PACG, primary angle closure suspect and Normal group respectively.

Mean values of AXL were 22.39mm, 23.07mm and 23.16mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values of ACD were 2.42mm, 2.74mm and 3.19mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values LT were 4.77mm, 4.32mm and 3.96mm among PACG, primary angle closure suspect and Normal group respectively.

Mean values LAF were 2.13, 1.88 and 1.71 among PACG, primary angle closure suspect and Normal group respectively.

Mean values RLP were 2.14, 2.12 and 2.23 among PACG, primary angle closure suspect and Normal group respectively.

**When PACG and primary angle closure suspect group were compared:**

1. IOP was significantly higher in PACG group.
2. K1, K2 significantly more in PACG group.
3. LT, LAF significantly more in PACG group.
4. AXL, ACD significantly less in PACG group.

**When PACG and normal group were compared:**

1. IOP was significantly higher in PACG group.
2. K1, K2 significantly more in PACG group.
3. LT, LAF significantly more in PACG group.
4. AXL, ACD, RLP significantly less in PACG group.

**When primary angle closure suspect and normal group were compared:**

1. IOP was significantly higher in primary angle closure suspect group.
2. LT, LAF significantly more in primary angle closure suspect group.

ACD, RLP significantly less in primary angle closure suspect group. Though AXL was less in primary angle closure suspect group when compared to normal, it was not statistically significant.

## Discussion

**Table 1: Comparative data on age distribution in different studies**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup>	57.45	54.4	49.95
Marchini et al <sup>5</sup>	64		57
Lan YW et al <sup>6</sup>	65.9	63.9	
Tomlinson A <sup>7</sup>	66.5		64.88
Saxena et al <sup>8</sup>	51.17		
Present study	62.52	52.35	49.95

Age distribution in various studies<sup>4,5,6,7,8</sup> shows that PACG is more common in elderly people. This increased incidence with age is explained by the increasing thickness of the lens, its forward movement and the resultant increase in iridolenticular contact. Age distribution in our study was similar to the study by George et al.<sup>4</sup>

**Table 2: Comparative data on sex ratio**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup> (Male:Female) in numbers	2:20	40:103	210:209
Marchini et al <sup>5</sup> (Male:Female) in numbers	13:41		
Lan YW et al <sup>6</sup> (Male:Female) in percentage	33:67	42:58	
Saxena et al <sup>8</sup> (Male:Female) in ratio	1:1.91		
Present study (Male:Female) in percentage	40:60	60:40	40:60

All the above mentioned studies<sup>4,5,6,8</sup> including our study show that PACG is commoner in females than males, as females have shorter eyes, shallower AC and thicker lenses.

The difference in mean IOP values between the 3 groups was statistically significant ( $p < 0.05$ ).

The difference in mean values of K1 and K2 between the 3 groups was statistically significant ( $p < 0.05$ ).

**Table 3: Comparative data on AXL**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup>	21.92	22.07	22.76
Marchini et al <sup>5</sup>	22.31	22.27	23.38
Lan YW et al <sup>6</sup>	22.39	22.39	23.13
Tomlinson A <sup>7</sup>	22.06	22.58	
Saxena et al <sup>8</sup>	22.25		23.26
Lin YW et al <sup>9</sup>	21.53		22.75
Present study	22.39	23.06	23.16

The above table shows that AXL was shortest in PACG group, shorter in primary angle closure suspect group when compared with normal subjects. AXL in this study was comparable to study by Marchini *et al.*<sup>5</sup>

**Table 4: Comparative data on ACD**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup>	2.63	2.53	3.00
Marchini et al <sup>5</sup>	2.41	2.77	3.33
Lan YW et al <sup>6</sup>	2.25	2.41	2.69
Tomlinson A <sup>7</sup>	2.75	3.17	
Saxena et al <sup>8</sup>	2.28		3.11
Lin YW et al <sup>9</sup>	2.28		2.87
Present study	2.42	2.74	3.19

As seen in the table 4, PACG group has shallowest ACD in all the studies. ACD is shallower in primary angle closure suspect group than in normal individuals. When ACD was compared, present study got values comparable to study by George *et al.*<sup>4</sup>

**Table 5: Comparative data on LT**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup>	4.23	4.40	4.31
Marchini et al <sup>5</sup>	5.10	4.92	4.60
Lan YW et al <sup>6</sup>	5.10	4.98	4.84
Tomlinson A <sup>7</sup>	5.23	4.67	
Saxena et al <sup>8</sup>	4.94		4.48
Lin YW et al <sup>9</sup>	4.56		4.13
Present study	4.77	4.32	3.96

All the above studies including our study show that PACG patients have thickest lens on comparison with primary angle closure suspect group and normal subjects.

**Table 6: Comparative data on LAF**

Study group	PACG	Primary angle closure suspect	Normal
George et al <sup>4</sup>	1.91	1.99	1.92
Marchini et al <sup>5</sup>	2.28	2.20	1.97
Lan YW et al <sup>6</sup>	2.28	2.23	2.09
Markowitz SN et al <sup>10</sup>	1.87	2.39	1.91
Present study	2.10	1.88	1.71

The above table shows that LAF increases from normal group to primary angle closure suspect group and to ACG group. LAF found in this study was comparable to LAF of Markowitz *et al.*<sup>10</sup> study.

**Table 7: Comparative data on RLP**

Study group	PACG	Primary angle closure suspect	Normal
Markowitz SN et al <sup>10</sup>	2.22	2.34	2.41
Lan YW et al <sup>3</sup>	2.19	2.21	2.15
Tomlinson A <sup>7</sup>	2.32		2.35
Present study	2.14	2.12	2.23

As seen in the Table 7: RLP was less in PACG group when compared to normal individuals. This shows that anteriorly situated lens predisposes to PACG.

This study showed that PACG patients have shorter axial length and crowded anterior segment. PACG and primary angle closure suspect group have distinctly shorter axial length and anterior chamber depth, thicker lens, higher lens thickness/axial length factor and as indicated by the relative lens position, a more anteriorly situated lens when compared to normal subjects.

PACG group have significantly shallower AXL, ACD and thicker lens than primary angle closure suspect group. Since both are stages in the progression of the disease, it was logically expected.

Our findings regarding AXL, ACD, LT, LAF and RLP show a significant progressive shift in biometric

characteristics from normal eyes to eyes with primary angle closure suspect and then to eyes with PACG.

However, there are few limitations of our study like smaller sample size, not comparing with findings of more sophisticated instrument like anterior segment OCT due to lack of access.

We conclude that the analysis of ocular biometric values is a simple, easily available and useful test that can be employed in primary angle closure suspect and primary angle closure glaucoma.

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**Conflict of Interest:** None

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