e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(5); 2135-2140

Original Research Article

Correlation of Ocular Biometry and Primary Open Angle Glaucoma: A Hospital Based Indian Population Study

Parul Danayak[1], Gunjan Valu[2], Hardik Patel[3]

[1]Professor (H.G.), Shri C. H. Nagri Eye Hospital, N.H.L. Municipal Medical College, Ahmedabad, India.

[2]PhD Scholar (Gujarat University) Assistant Professor, Narendra Modi Medical College, L. G. Hospital, Ahmedabad, India.

[3]Senior Resident, Narendra Modi Medical College, L. G. Hospital, Ahmedabad, India.

Received: 17-03-2023 / Revised: 30-03-2023 / Accepted: 30-04-2023

Corresponding author: Dr Gunjan Valu

Conflict of interest: Nil

Abstract

Purpose: To study the correlation between myopic refractive error (MRE), axial length (AL) and corneal power (CP) with primary open angle glaucoma (POAG) in adult Indian population.

Methods: A cross sectional study including 120 eyes of 60 subjects (32 males; 28 females) with a mean age of 50.39± 7.25 years was undertaken at a tertiary eye care hospital. All the subjects underwent standardized clinical examination including visual acuity testing, slit lamp examination, Intra Ocular Pressure (IOP) measurement with Perkins Applanation Tonometer, refraction, fundus examination, gonioscopy, pachymetry and visual field examination. Zeiss IOL Master 500 was used to measure AL and CP. Chi-square procedures and unpaired t test procedures were used to find out the significance value and odds ratio.

Results: IOP recorded for POAG group (18.52±2.87mmHg) on treatment was significantly higher than the control group (14.93±1.96 mm Hg) ($P < 0.0001$). There was no statistical difference in the central corneal thickness (CCT) readings between the POAG group (0.512±0.027mm) and control group(0.516±0.029) (OR: 0.73; CI: 0.32-1.6; P=0.59). Myopia was found to be significantly associated with POAG (OR 3.22; CI: 1.39 to 7.46 95% confidence interval; P= 0.009). Longer AL (OR: 14.4; CI: 4.97- 41.71 95% confidence interval; P<0.0001) and flatter corneas (OR: 4.81 CI: 2.02-11.41 95% confidence interval; P=0.0005) were also associated with POAG.

Conclusion: This study shows that subjects with myopic refractive errors, longer axial lengths and flatter corneas were at a higher risk for developing POAG.

Keywords: Myopic Refractive Error, Axial Length, Corneal Power, Primary Open Angle Glaucoma.

Introduction

Glaucoma is the second leading cause of blindness worldwide, approximately 6.7 million people are blind due to glaucoma. Approximately 66.8 million people in the world suffer from primary open angle glaucoma [1]. The prevalence of glaucoma varies by region and race. Various population studies of glaucoma have shown that high

intraocular pressure, which has been considered as the main risk factor of primary open angle glaucoma (POAG), is not always observed [2]. India being the second most populated country, the impact of visual disability and blindness from glaucoma is likely to be costly.

There are studies which have reported a strong increase in the prevalence of glaucoma with age; differences in prevalence between genders and genetic correlation of glaucoma [3]. A very limited data is available regarding the various biometric characteristics associated with POAG in Indian eyes. The Aravind Comprehensive Eye Survey and the Andhra Pradesh Eye Disease study provides some information on the prevalence and risk factors of POAG in rural and urban population of Southern India; but have not taken into account the various biometric characteristics like axial length(AL) and corneal power (CP) which are found to be associated with POAG [4,5].

The relationship between refractive error and glaucoma has been investigated in several clinical trials and population based studies [6]. Myopic refractive error has long been associated with POAG. This study was undertaken to evaluate the relationship between myopic refractive error, axial length and corneal power; and prevalence of POAG in the Indian population.

Materials and Methods

A cross sectional observational study was conducted at a tertiary eye care hospital on 120 eyes of 60 subjects for the duration of 8 months. Written informed consent was obtained from all patients who participated in the study. This study adhered to the tenets of declaration of Helsinki. The subjects were randomly selected from those visiting the hospital for correction of their refractive error and those having primary open angle glaucoma. Patients with aphakia, pseudophakia, eyes with angle closure glaucoma and secondary glaucoma, grade II of nuclear sclerosis (LOCS classification), history of previous ocular surgery and any systemic illness were excluded from study. Patients more than 18 years of age and not having any exclusion criteria were included in the study. Complete history of the patients regarding ocular complaints, demographic profile and other systemic illness was taken. Detailed ophthalmologic examination including visual acuity testing, slit lamp examination, objective and subjective refraction was done. Intraocular pressure was measured using Perkins hand held Applanation Tonometer. Gonioscopy was done with Zeiss 4 mirror goniolens. Central corneal thickness (CCT) measurement was done using TOPCON SP 2000P Specular Microscope Pachymeter. Visual field assessment was done using Humphry Perimeter. Dilated fundus evaluation was done including details of optic disc. IOL (Intraocular lens) master [Zeiss IOL Master Advanced Technology Software Release 5-XX] readings were taken for measuring axial length (AL) and Corneal Power (CP). An average of 3 readings for CP and an average of 5 readings for AL were considered. POAG was defined as open angles on gonioscopy and glaucomatous optic disc changes with corresponding visual field defects. Low myopia and moderate to high myopia were defined as refractive errors of <-3.00DS and ≥ -3.00 DS respectively. All data were entered in Microsoft excel spreadsheets.

Graph Pad Instat 3 software was used to analyse the data. Chi - square procedures were used to test the associations of categorical variables (age, gender and refractive error) and unpaired t test procedures were used to test continuous variables (IOP, CP and AL). Non parametric test was used in unpaired t test when data failed the normality test.

Results

In our study, 120 eyes of 60 patients were assessed which included 32 male patients (53%) and 28 female patients (47%). All subjects were in the age groups of 35-65 years (Mean age: 50.39± 7.25 years).

POAG was observed in 44 patients which were placed under the POAG group and the remaining 16 patients under the control group [Males 59%, females 41%; OR 2.40; CI 1.04 to 5.53; P= 0.04]. 82(68.33%) eyes were having best corrected visual acuity (BCVA) of 6/6 on snellen's distance vision chart while 22(18.33%) eyes were having BCVA of 6/9 and 16(13.33%) eyes had BCVA of 6/12. Mean IOP of all patients were 17.56 ± 3.09 mmHg while in POAG patients it was 18.52 ± 2.87 mmHg with range of 12 to 26 mmHg and in normal patients it was 14.93 ± 1.96 mmHg. (Table 1) There was a statistically significant difference observed in the mean IOP of patients with POAG and normal patients. (Relative Risk = 1.762, 95% CI 1.444 to 2.150; P<0.0001)

Table 1: Intra Ocular Pressure reading in all, POAG and normal patients

Study Group	Mean ± SD (mmHg)	Median (mmHg)
All patients	17.56 ± 3.09	18
POAG patients	18.52 ± 2.87 (Range : 12 to 26)	19
Normal patients	14.93 ± 1.96	15

On dilated disc evaluation, out of 88 eyes, 36(40.9%) eyes were having 0.6 C:D ratio with deep cup with nasalization of vessels, 31(35.2%) eyes were having 0.6-0.7 C:D ratio with superior/ inferior notching/ rim thinning with nasalization and lamellar dot sign. While 16(18.18%) eye has 0.7 C:D ratio with bayonatting sign and isolated rim thinning and 5(5.61%) eyes has 0.8 C:D ratio with superior and inferior rim thinning and peripapillary atrophy. Regarding visual field defects, 33 (37.5%) eyes were having nasal step, 19(21.6%) with isolated paracentral scotoma, 17(19.31%) having superior arcuate scotoma, 13(14.7%) with inferior arcuate scotoma and 6(6.81%) with double arcuate scotoma. (Chart 1)

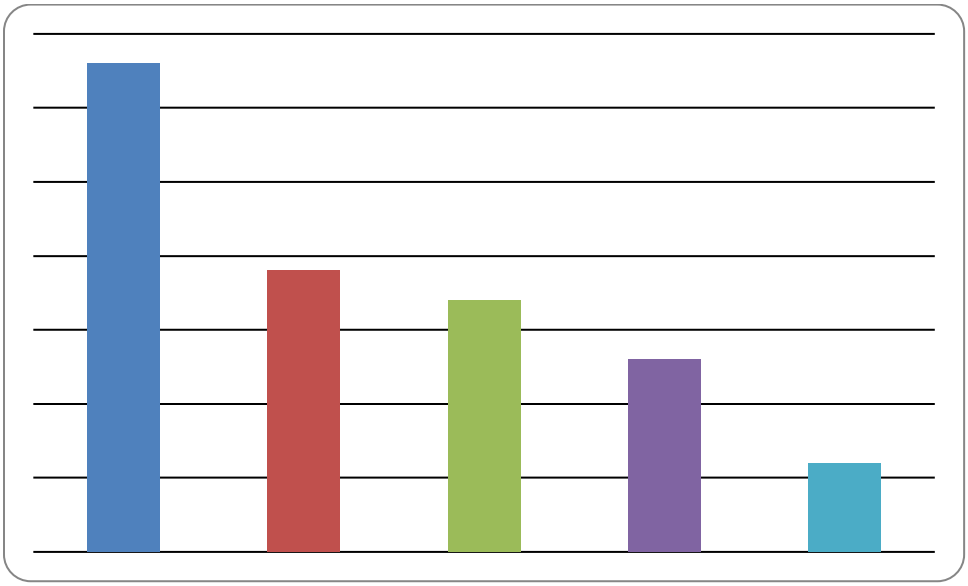

Chart 1: Visual field defects in patients with POAG

Mean CCT was 0.513 ± 0.028 mm in all patients while the same was 0.512 ± 0.027 mm in POAG patients and 0.516 ± 0.029 mm in normal patients. No significant difference was found on comparing CCT in PAOG and control group. (OR 0.73; CI: 0.32-1.6; P=0.59).

Out of 88 POAG eyes, 58 (66%) were myopic [58.6%: moderate/high myopes and 41.30% : low myopes](P=0.01; statistically significant) and 30 (34%) were nonmyopic. This shows that myopic refractive error was significantly associated with POAG (OR 3.22; CI 1.39 to 7.46, 95% CI; P=0.09). (chart 2)

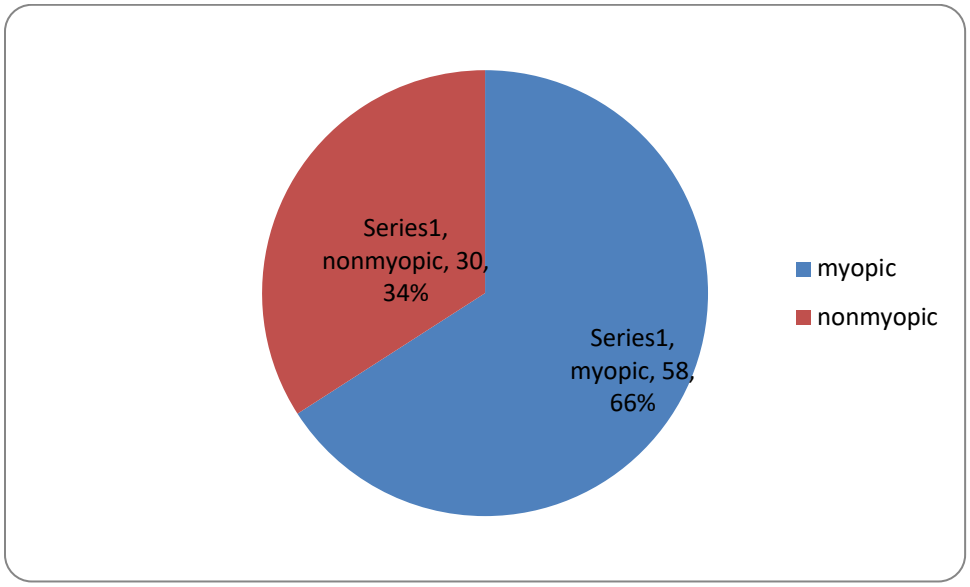

Chart 2: POAG and myopic refractive error

Mean axial length of all subjects were 23.94 ± 1.10 mm while in POAG patients it was 24.33 ± 0.89 mm and the same was 22.87 ± 0.90 mm in normal patients. Eyes with POAG were found to have longer axial length as compared to eyes not having POAG (OR 14.4; CI 4.97-41.71, 95% confidence interval; (p<0.0001, relative risk 1.97 95% confidence interval 1.46-2.65). Myopic refractive errors and axial length were correlating moderately (r=0.66; confidence interval 95% 0.48-0.78; r squared = 0.44)

Mean corneal power was 43.54± 1.14 D in all patients, 43.22 ± 0.78 D in normal patients and 44.38 ± 1.48 in patients with POAG. Eyes with flatter corneas were at more risk of developing POAG as compared with eyes of control group (OR 4.81; CI 2.02-11.41 95% confidence interval P=0.0005; Relative Risk 1.56, 95% confidence interval 1.18-2.07). (Table 2)

Table 2: Mean CCT, AL and CP in all patients, POAG and normal patients with their statistical significance

	Central Corneal Thickness	Axial Length	Corneal Power
All Patients	0.513 ± 0.028 mm	23.94 ± 1.10 mm	43.54± 1.14 D
POAG Patients	0.512 ± 0.027 mm	24.33 ± 0.89 mm	44.38 ± 1.48 D
Normal Patients	0.516 ± 0.029 mm	22.87 ± 0.90 mm	43.22 ± 0.78 D
Statistical Significance	P=0.59	P<0.0001	P=0.0005

Discussion

In our study, males were more affected with POAG than females (OR 2.40 CI 1.04 to 5.53, P = 0.04). The same was observed in a study by Doshi *et al*. and Ramakrishnan *et al* [1,4].

The mean IOP for POAG group was 18.52± 2.87 mmHg and for control group was 14.93 ±1.96 mmHg. Raised IOP is major risk factor for development of POAG. Yasuyuki *et al*, Garudadni *et al* and Kuzin *et al* also reported an association between higher IOP and POAG [2,5,7]

The mean CCT for POAG was 0.512 ± 0.027 mm and for control group was 0.516± 0.029 mm in our study, which was not a significant factor affecting POAG (OR 0.73; CI 0.32-1.6; P=0.59). This result correlates with the results found by Yusuyuki *et al*, Perera *et al* and Kuzirn which also showed that CCT was not a risk factor affecting POAG [2,6,7]. There is association between thin cornea and development of optic nerve damage while thick cornea may give false IOP readings.

Myopic error was found to be more associated with POAG. Out of total POAG eyes, 66% patients were myopic & 34% patients were nonmyopic. Out of 58.6% moderate/high myopes and 41.3% low myopes, moderate/high myopes were significantly associated with POAG. Studies by Yasuyuki *et al* and Aaron A Kuzir *et al* also showed myopia as a significant risk factor for POAG [2,7]. In the Barbados and the Blue Mountains Eyes study, myopic subjects showed a significantly higher prevalence of glaucomatous optic nerve damage [8].

The mean AL for POAG group was 24.33 ± 0.89 mm while for control group was 22.87 ± 0.90mm. Longer AL was significantly associated with POAG. Studies by Shamira A Perera *et al* and Aaron A Kuzir *et al* also reported a longer AL with POAG [6,7]. The mean CP for POAG group was 43.22 ± 0.78D and for control group was 44.38 ± 1.48D. Flatter corneas were significantly associated with POAG.

Many hypotheses have been attempted to explain the association between myopia or increased AL and glaucoma. One explanation put forward is an increased cup to disc ratio found in myopes which may increase risk of damage to ganglion cell axons [7-9]. Also, alterations in connective tissue and scleral rigidity; as well as exaggerated shearing forces across the lamina cribrosa found in myopes may contribute to the greater susceptibility of optic nerve damage in myopes [10-12].

The measurement of AL and CP by noncontact partial coherence interferometry instead of ultrasonographic methods and the use of subjective refraction by trained optometrists instead of autorefraction increase the robustness of this study.

Both biometric measurements: AL and CP may have a significant relationship with the biologic mechanisms responsible for the pathogenesis of glaucoma. These genetic factors, both of which can be easily measured in a clinical set up, should be considered when assessing persons who are at risk of having POAG.

Limitations

Since this study was cross sectional in nature, the conclusions drawn about the effect of myopia and biometric characteristics on POAG are not based on longitudinal data. A cohort study is required to find out whether myopia is associated with subsequent risk of POAG. Another limitation is that this data were based on single measurements of refraction, IOP, AL and CP. Also the study had a small sample size and when the participants were categorized into various groups, the same sample size became further

smaller which could affect the data results. The POAG and control groups sample size were unequal which could have affected the final results.

References

1. Doshi V, Ying-Lai M, Azen SP, Varma R. Sociodemographic, family history, and lifestyle risk factors for open-angle glaucoma and ocular hypertension. The Los Angeles Latino Eye Study. Ophthalmology. 2008; 115:639–647.
2. Yasuyuki Suzuki Yasuyuki Suzuki, MD, PhD, Aiko Iwase, MD, PhD, Makoto Araie, MD, PhD et al. Risk Factors for Open-Angle Glaucoma in a Japanese Population The Tajimi Study: Ophthalmology 2006; 113; 1613-1617 Ameican Academy of Ophthalmology
3. Weih L.M., Nanjan M., McCarty C.A., Taylor H.R. Prevalence and predictors of open-angle glaucoma: results from the visual impairment project. Ophthalmology. 2001;108(11):1966–1972.
4. R Ramakrishnan, MD, Praveen K Nirmalan, MD, MPH, R Krishnadas, MD, R.D Thulasiraj, MBA, James M Tielsch, PhD, Joanne Katz, PhD, David S Friedman, MD, MPH, Alan L Robin, MD Glaucoma in a rural population of southern India The Aravind comprehensive eye survey. Ophthalmology 2003; 110; 1484-1490 American Academy of Ophthalmology
5. Chandrasekhar Garudadri, FRCS, Sirisha Senthil, FRCS, Rohit C. Khanna, MD, Krishniah Sannapaneni, Harsha B. Laxmana Rao, MD, DNB Prevalence and Risk Factors for Primary Glaucomas in Adult Urban and Rural Populations in the Andhra Pradesh Eye Disease Study. Ophthalmology 2010:117:1352-1359 American Academy of Ophthalmology
6. Perera SA, Wong TY, Tay WT, Foster PJ, Saw SM, Aung T. Refractive error, axial dimensions, and primary open-angle glaucoma: the Singapore Malay Eye Study. Arch Ophthalmol. 2010;128(7):900–905
7. Aaron A. Kuzin, MD, Rohit Varma, MD, MPH, Harsha S. Reddy, MD, Mina Torres, MS, and Stanley P. Azen, PhD, the Los Angeles Latino Eye Study Group Ocular Biometry and Open Angle Glaucoma: The Los Angeles Latino Eye Study Ophthalmology. 2010; 117: 1713–1719.American Academy of Ophthalmology
8. Jonas JB, Dichtl A. Optic disc morphology in myopic primary open-angle glaucoma. Graefes Arch Clin Exp Ophthalmol. 1997;235(10):627–33.
9. Jonas JB, Gusek GC, Naumann GO. Optic disk morphometry in high myopia. Graefes Arch Clin Exp Ophthalmol 1988;226: 587-90
10. Cahane M, Bartov E. Axial length and scleral thickness effect on susceptibility to glaucomatous damage. pdf. Ophthalmic Res. 1992; 24:280–284.
11. Quigley, H.A. Reappraisal of the mechanisms of glaucomatous optic nerve damage. Eye (Lond). 1987; 1:318–322.
12. Curtin BJ, Iwamoto T, Renaldo DP. Normal and Staphylomatous Sclera of High Myopia. Arch Ophthalmol. 1979; 97(5):912–5.