CORRELATION OF ANTERIOR CHAMBER DEPTH WITH PERIPAPILLARY NERVE FIBER LAYER THICKNESS

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ABSTRACT

Objective: To determine correlation of anterior chamber depth with peripapillary nerve fiber layer thickness.
Study Design: Descriptive cross sectional study.
Place and Duration of study: Armed Forces Institute of Ophthalmology Rawalpindi, from Apr 2016 to Oct 2016.
Patients and Methods: Anterior chamber depth and peripapillary nerve fiber layer thickness was measured in 200 eyes of 110 patients, between 10-40 years of age. Anterior chamber depth was measured in mm, by taking average of 3 readings, measured by optical biometry (IOL Master, Carl Zeiss Meditec, Dublin whereas average peripapillary retinal nerve fibre layer pRNFL thickness was obtained by taking average of 12 segments RNFL thickness measurement, calculated by Spectral domain optical coherence tomography (SD OCT) (3D OCT-1000 Markll, Topcon Co, Tokyo, Japan) after dilating pupils with one drop of 1% Tropicamide, instilled three times, 10 minutes apart. Three readings were taken for each eye. The mean of the three readings was used for the analysis. Pearson correlation (+1/-1) was calculated between anterior chamber depth, peripapillary nerve fiber layer thickness and age.
Results: Two hundred eyes of 110 patients were included in the study. Both eyes were considered in 90% of the patient, however only Right eye was considered in 6.3% of the patients while left eye in 3.7% of the patients. Mean age of the patients was 26.58 ± 8.88 years. Mean visual acuity of patients measured by log MAR was 0.52 ± 0.12. Mean Anterior chamber depth (ACD) of patients was 3.41 ± 0.35 while mean RNFL appeared to be 103.26 ± 8.89 um.
Conclusion: It was concluded that anterior chamber depth was neither related significantly with peripapillary nerve fiber layer nor with age.

Keywords: Anterior chamber depth, Glaucoma, Peripapillary nerve fiber layer thickness.

INTRODUCTION

Anterior chamber (AC) is the aqueous humor filled cavity bounded anteriorly by the corneal endothelium and posteriorly by the plane of iris. The normal anterior chamber depth (ACD) is 2.5 mm to 3.5 mm, and is a key determinant of angle of the AC, formed between peripheral corneal endothelium and plane of the iris[1]. Measurement of ACD is of particular value in categorization of glaucoma into open angle and closed angle glaucoma. Variations in ACD has been associated with variety of glaucoma sub-types[2]. ACD assessment is helpful in evaluating angle closure, patency of peripheral iridotomies, suitability of AC implants, diagnosis of secondary glaucomas such as pigmentary, pseudoexfoliation and neovascular glaucoma[3,4]. ACD is found to vary in individuals depending upon refractive status, age, axial length, race[5]. ACD is assessed clinically by different methods which include Smith method and Van Herrick method[6]. More sophisticated instruments to measure ACD include Ultrasound biomicro-scopy, scheimpflug imaging and optical biometry[7].

Thickness of peripapillary retinal nerve fibre layer (pRNFL) has been recently considered as having pivotal importance in diagnosis of glaucoma. Since both ACD and pRNFL are dependent on axial length of eye, it may be possible that a correlation between these two ocular parameters may exist[8]. Very few studies

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have so far shown the relationship of ACD with pRNFL thickness[9,10]. The available international literature shows variable results while there has been no local study in our population that has studied the correlation between ACD and pRNFL. Therefore, we carried out this study in order to find out correlation between these two important parameters used in glaucoma diagnosis. The clinical assessment of ACD may alone be helpful in glaucoma diagnosis which is the rationale behind conducting this study.

MATERIAL AND METHODS

This cross sectional study was carried out at Armed Forces Institute of ophthalmology, Rawalpindi from Apr 2016 to Oct 2016. The sample size was calculated using WHO calculator which appeared to be 200 eyes. Each eye of the patients was considered separately. Non probability purposive sampling technique was used to include the patients in the study group. Young healthy patients with age ranging from 10 to 40 years who reported for refractive error assessment were included in the study. All those patients with best corrected visual acuity BCVA less than 20/20 or suffering from glaucoma, corneal diseases, trauma, ocular surgery, high myopia, Cataract, retinal diseases like diabetic and hypertensive retinopathy, Optic disc anomalies were excluded from the study. Initially 154 patients were screened, however a total of 200 eyes of 110 patients were finally selected and included in the study. After approval by the ethical committee, AFIO Rawalpindi, informed consent was taken from all the included subjects. Complete ophthalmic clinical examination including uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), slit lamp examination of anterior and posterior segments and IOP measurement was carried out in all the patients. Patients underwent measurement of ACD using optical biometry (IOL Master, Carl Zeiss Meditec, Dublin, CA, USA). Three reading were taken and average of the three was noted down. After dilating pupils with one drop of 1% Tropicamide, instilled three times, 10 minutes apart, pRNFL thickness were measured using SD OCT (3D OCT-1000 Markll, Topcon Co, Tokyo, Japan) and average pRNFL thickness were obtained by taking average of 12 segments RNFL thickness measurement.

Statistical Analysis

Data was evaluated and analyzed using statistical program for social sciences (SPSS) version 22. Mean and Standard deviation were noted for continuous variables (Age, ACD, pRNFL thickness) while frequency and percentage were calculated for nominal/ordinal data (Gender). Pearson correlation coefficient is calculated to evaluate relationship between ACD and pRNFL thickness. Considering *p*-value of ≤0.05 to be statistically significant.

Table-I: Frequency distribution of various categorical variables.

Variables		Frequency	Percentage (%)
Gender (n=110)	Males	74	67.2
	Females	36	32.72
Laterality (n=200)	Right	16	8.00
	Left	04	2.00
	Bilateral	180	90.00

Table-II: Pearson Correlation of RNFL with ACD and Age.

	ACD	Age
Correlation of RNFL (r)	0.017	-0.126
p-value	0.814	0.075

RESULTS

Two hundred eyes of 110 patients were included in the study. Both eyes was considered in 90% of the patient, however only Right eye was considered in 16 % of the patients while left eye in 4% of the patients (table-I). Age of patients

ranged from 10 to 40 years with a mean of 26.58 ± 8.88 years. Visual acuity of patients measured by log MAR scale varied from 0 to 1with a mean of 0.52 ± 0.12. Mean ACD of patients was 3.41 ± 0.35 while mean RNFL appeared to be 103.26 ± 8.89 um. The correlation of ACD with RNFL is given table-II.

DISCUSSION

ACD is strongly associated with the various types of glaucoma. Deeper AC is associated with primary open angle and pigment dispersion while narrow angles is generally related with narrow angle and closed angle glaucomas[10]. ACD has important implications in diagnosis as well as follow-up of glaucoma patients. Various methods such as gonioscopy, slit beam on slit lamp examination, IOL master, ultrasound biomicroscopy (UBM), and anterior segment optical coheherence tomography (AS-OCT) can be used to analyze the anterior chamber angle[7,10,11]. Diagnosis of glaucoma has been the center of attention of ophthalmic research because of irreversible damage to optic nerve and poorer prognosis in delayed diagnosis[11]. Glaucoma is believed to affect peripapillary retinal nerve fibre layer (pRNFL) thickness, measurement of which has revolutionized the diagnosis of glaucoma in recent years. The changes in pRNFL thickness are believed to precede the functional damage, however, this thickness is influenced by many factors other than raised intraocular pressure[12]. These factors include age, race, sex, axial length, refractive status etc[13]. Similarly, number of factors have been regarded as having effect on ACD such as age, gender, race and refractive status[14]. Breslin et al reported that boys have deeper AC as compared to girls and furthermore, the depth of AC continues to increase till 10 years of age. In the same way Myopes have higher ACD than their other refractive counterparts[15].

Lee et al in their study on 200 subjects revealed that average ACD 3.35 mm ± 0.4 mm and average pRNFL thickness was 102µm ± 11µm. There was statistically significant negative correlation between ACD and pRNFL thickness[16]. However, Klamann MK and colleagues concluded in their study that there is no such relation between ACD and pRNFL thickness[17]. We, in our study found out that there was a positive correlation between ACD and pRNFL (r=0.017). Similarly there was a negative correlation between ACD and age (r=-0.126). However, both these correlations were statistically insignificant with *p*-value greater than 0.05 (table-III). The same was reported by Lee[16]. However, Lee also analyzed ACD in different refractive groups (myopia, emmetropia and hyperopia) and found a deeper ACD in myopes. Same was reported by another study carried out by Urban et al[18].

LIMITATIONS OF STUDY

Though findings of our study are significantly important, we believe that there were few limitations as well. Firstly the age group that was considered in this study was young adults (mean 26.58 years), however, the general age of glaucoma incidence is above 40 years. Secondly, we didn't analyze the ACD depth in reference to type of refractive error as considered by Lee et al in their study. Thirdly, the RNFL in separate quadrants of optic disc was also not studied in detail. Despite these limitations, this study was first of its kind which was conducted in Pakistani population, however more comprehensive studies should be conducted.

CONCLUSION

It was concluded that anterior chamber depth was neither related significantly with peripapillary nerve fiber layer nor with age.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

REFERENCES

1. Hwang HS, Park SK, Kim MS. The biomechanical properties of the cornea and anterior segment parameters. BMC Ophthalmol 2013; 13: 49.
2. Smith SD, Singh K, Lin SC, Chen PP, Chen TC, Francis BA et al. Evaluation of the anterior chamber angle in glaucoma: A report

by the american academy of ophthalmology. Ophthalmology 2013; 120(10): 1985-97.
3. Birner B, Tourtas T, Wessel JM, Jünemann AG, Mardin CY, Kruse FE, et al. Pigment dispersion syndrome and pigmentary glaucoma. Morphometric analysis of the anterior chamber segment with SL-OCT. Ophthalmologe 2014; 111(7): 638-43.
4. Nongpiur ME, Khor CC, Jia H, Cornes BK, Chen LJ, Qiao C, et al. ABCC5, A gene that influences the anterior chamber depth, is associated with primary angle closure glaucoma. PLoS Genet 2014; 10: e1004089.
5. Hassen GW, Sweeney B, Portillo T, Ali D, Nazeer O, Habal R, et al. Anterior chamber depth measurement using ultrasound to assess elevated intraocular pressure. Am J Emerg Med 2015; 33(6): 860-3.
6. Mosler MP, Werner JU, Lang GK. [Chamber Angle Assessment in Clinical Practice - A Comparison between Optical Coherence Tomography and Gonioscopy]. Klin Monbl Augenheilkd 2015; 232(7): 874-80.
7. Savini G, Hoffer KJ, Carbonelli M. Anterior chamber and aqueous depth measurement in pseudophakic eyes: Agreement between ultrasound biometry and scheimpflug imaging. J Refract Surg 2013; 29(2): 121-5.
8. Park SH, Park KH, Kim JM, Choi CY. Relation between axial length and ocular parameters. Ophthalmologica 2010; 224(3): 188-93.
9. Jonas JB, Nangia V, Gupta R, Khare A, Sinha A, Agarwal S, et al. Anterior chamber depth and its associations with ocular and general parameters in adults. Clin Experiment Ophthalmol 2012; 40(6): 550-6.
10. Nongpiur ME, Sakata LM, Friedman DS, He M, Chan YH, Lavanya R, et al. Novel association of smaller anterior chamber width with angle closure in Singaporeans. Ophthalmol 2010; 117(10): 1967-73.
11. Cheung CY, Chen D, Wong TY, Tham YC, Wu R, Zheng Y, et al. Determinants of quantitative optic nerve measurements using spectral domain optical coherence tomography in a population-based sample of non-glaucomatous subjects. Invest Ophthalmol Vis Sci 2011; 52(13): 9629-35.
12. Bussel II, Wollstein G, Schuman JS. OCT for glaucoma diagnosis, screening and detection of glaucoma progression. Br J Ophthalmol 2014; 98 (Suppl 2): 15-9.
13. Hong SW, Lee SB, Jee DH, Ahn MD. Interocular retinal nerve fiber layer thickness difference in normal adults. PLoS One 2015; 10(2): e0116313.
14. Qin B, Tang M, Li Y, Zhang X, Chu R, Huang D. Anterior segment dimensions in Asian and Caucasian eyes measured by optical coherence tomography. Ophthalmic Surg Lasers Imaging 2012; 43(2): 135-42.
15. Breslin KMM, Donoghue LO, Saunders KJ. A prospective study of spherical refractive error and ocular components among Northern Irish school children (the NICER study). Invest Ophthalmol Vis Sci 2013; 54(7): 4843-50.
16. Lee JW, Yau GS, Woo TT, Yick DW, Tam VT, Yuen CY. The anterior chamber depth and retinal nerve fiber layer thickness in children. Sci World J 2014; 538283.
17. Klamann MK, Gonnermann J, Maier AK, Ruokonen P, Bertelmann E, Torun N. Influence of anterior chamber depth on optic disc measurements with OCT and HRT 3. Klin Monbl Augenheilkd 2013; 230(10): 1029-33.
18. Urban B, Kretowska M, Szuminski M, Bakunowicz-Lazarczyk A. Evaluation of anterior chamber depth measurements in emmetropic, hypermetropic and myopic eyes in children and adolescents using OCT Visante. Klinika Oczna 2012; 114(1): 18-2.

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