CentralCorneaThicknessinGlaucomaandNon-GlaucomaAfricanPopulation

ABSTRACT

Aim: Todeterminethepatternofcentralcorneathickness(CCT)inanindigenous Africanpopulation attending the glaucoma clinic at University College Hospital (UCH), Ibadan, Nigeria andidentify its relationshiptospecific open angleglaucoma(OAG)entities in order toadministerappropriatetreatments.

StudyDesign: Thisisahospitalbasedcasecontrolstudy.

Methods: 340 eyes of 170 consecutive glaucoma patients attending the eye clinic and 340 eyes of170 consecutive non-glaucoma patients attending the general outpatient department (GOPD) clinicof the UCH, Ibadan, Nigeria between August 2009 and June 2010 who met the inclusion criteriawererecruitedintothestudy.

Detailedocularexaminationwasperformedonallparticipants.

Results: Themeanageofglaucomagroupwas55.7±9.9yearscomparedto53.3years±8.4

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years in non-glaucoma group. The mean CCT of all eyes was 530μm. The mean CCT was found to decrease with age in both groups.

Conclusion: The study confirms there was no significant relationship between central cornea thickness and specific open angle glaucoma.

1. INTRODUCTION

Central cornea thickness (CCT) is the measurement of the thickness of the central part of the cornea. It has an influence on cornea rigidity and consequently could affect the accuracy of intraocular pressure (IOP) measurement by Goldmann applanation tonometry (GAT) [1]. The influence of CCT on the accuracy of IOP measurements was acknowledged in the first description of the Goldman tonometer by Goldman and Schmidt in 1957 and has become a topic of much interest [2]. IOP is one of the most important parameters in the detection and monitoring of response to treatment of glaucoma in routine clinical practice [3,4]. Studies have shown that open angle glaucoma (OAG) is an important cause of blindness worldwide and glaucoma is the second leading cause of blindness globally [5,6]. Over 8.4 million people globally were bilaterally blind from primary glaucoma in 2010. This number may rise to 11.1 million by 2020 [5]. OAG has been said to disproportionately affect those of African derivation [5]. The prevalence rate of OAG is higher in Africans, it seems to begin in the younger age group and is more aggressive than in Caucasians [7]. Reports from Africa also indicate that most people with glaucoma are not aware of having the disease and at least half of eyes are already blind at presentation [8,9]. The Nigeria national blindness and visual impairment survey revealed that glaucoma was the second commonest cause of blindness in Nigeria [10]. And as the proportion of those over age 40 years increases, the proportional increase in glaucoma will challenge our resources and ingenuity. Therefore information on the pattern of CCT in our indigenous African population is pertinent so as to aid our diagnosis and management of glaucoma patients. The knowledge of CCT will be important in managing our patients either suspected of having OAG, normal tension glaucoma (NTG) or diagnosed with it because IOP is arguably the most important and only modifiable risk factor for glaucoma progression and it is known to be influenced by CCT.

2. MATERIALS AND METHODS

This hospital based case control study was conducted in the Eye clinic and General Outpatient Department (GOPD) of the UCH, Ibadan, Oyo State, Nigeria. The hospital offers quality patient care in all specialties of Medicine and Surgery and serves as a major referral centre for other hospitals in south-western Nigeria and other parts of the country.

All consecutive new and follow up patients that met the inclusion criteria below and who were seen at the eye clinic and GOPD of the hospital from August 2009 to June 2010 were recruited.

2.1 Inclusion Criteria for Glaucoma Subjects

Patients were recruited from the glaucoma clinic of the eye clinic:

i) Adults 40 years and above, both newly diagnosed cases of OAG and those already on treatment for glaucoma.
ii) Diagnosis of primary glaucoma in these patients was based on optic disc changes (assessment of the thickness, symmetry, colour of neuroretinal rim, notching and retina nerve fibre loss) associated with glaucoma typically examined with non contact examination lens (+78D).
iii) Visual field defects on automated perimetry typical of glaucoma that cannot be explained by other pathology (minimal change of paracentral, small, relatively steep depressions, most commonly supero nasally)
iv) Gonioscopically open angles in at least 270°.
v) No evidence of corneal pathology.

NTG patients had IOP ≤ 21 mmHg after diurnal phasing with visual field and disc changes of glaucoma.

2.2 Inclusion Criteria for Non-glaucoma Subjects

i) Healthy adults, 40 years and above with no suspicion of any form of glaucomatous optic nerve damage and visual field changes attributable to glaucoma or eye disease.
ii) Subjects not on any treatment for glaucoma and did not have elevated IOP, (IOP ≤ 21 mmHg in both eyes) or family history of glaucoma.
iii) Subjects with no evidence of cornea or anterior segment disease, contact lens wear or previous eye surgery.

2.3 Exclusion Criteria for Glaucoma Subjects

i) Adults younger than 40 years of age.
ii) Those who had concomitant ocular disease, previously used contact lens or steroids.
iii) Patients with systemic disease or on medications known to affect visual field or associated with corneal pathology.
iv) All angle closure, pseudo exfoliation, pigmentary glaucoma and ocular hypertension patients.
v) Patients who declined recruitment into the study.

2.4 Exclusion Criteria for Non-glaucoma Subjects

i) Subjects who are younger than 40 years.
ii) Those with evidence of glaucomatous optic nerve damage and visual field changes attributable to glaucoma or eye disease.
iii) Subjects with any evidence of recent or previous treatment for glaucoma or elevated IOP≥21 mmHg, contact lens wear, previous eye surgery, glaucoma suspects or family history of glaucoma.
iv) Subjects with any systemic diseases associated with corneal pathology
v) Subjects who refused to participate in the study.

2.5 Sample Size

Using an anticipated minimum difference of 10(μ) in CCT and a standard deviation of CCT in non glaucoma subjects of 30.3 (μ), a sample size of 160 subjects was arrived at assuming an alpha(α) error of 0.05 and a power of 80%.170

subjects in each group completed the study and were included in further analysis.

2.6 Study Procedure and Data Collection

Information with the aid of the structured questionnaire included basic demographic data, past medical history (diabetes mellitus, hypertension), family history of glaucoma, history of ocular surgery, number of glaucoma medications and year of diagnosis of glaucoma.

Detailed ocular examinations of the anterior and posterior segments were performed Visual acuity was tested using a Snellen chart or an illiterate Echart.

Slit lamp examination of the anterior segment was performed using Haag Streit Slit Lamp BM900 and a Goldman applanation tonometer was used to measure the IOP. CCT was measured using ultrasonic pachymeter (Sonomed PAC SCAN 300AP) after instillation of amethocaine 0.4% eye drop.

The CCT measurement was recorded from a seated patient by using the hand held ultrasonic pachymeter probe gently placed in the mid-pupillary axis of the cornea with the pupil undilated. Three measurements expressed in micrometers were taken and the mean was recorded.

IOP was measured twice in each eye, in the morning and afternoon (a minimum four hours difference) because of the diurnal variation in IOP. An average of the two measurements was taken. It was measured three times in patients suspected to have NTG with a minimum of two hours difference. The average of the measurements were taken.

On gonioscopy, the angle of the anterior chamber was considered open when at least the sclera spur could be identified.

Dilated fundoscopy was performed using +78D non contact lens on all the participants. Pupillary dilation was achieved with a drop of 1% tropicamide eye drop and 2.5% phenylephrine eye drop in eyes whose anterior chamber was not shallow and gonioscopy showed open angles.

Central Visual Field (CVF) was performed on all glaucoma patients who could fixate and on non glaucoma patients using the Humphrey Field

Analyzerperimeter(CarlZeissMeditecHFAModel 740 U) and standard 24-2 SITA strategy.The median deviation (MD) and pattern standarddeviation(PSD)valueswererecorded.Asa preliminaryrequirement,theperimetryhadtofulfillth ereliabilitycriteriadefinedbyfixationlosses ≤ 20%, falsepositive ≤ 33% andfalsenegative ≤ 33%. All patients had auto refractiondoneusingthe Acuitus 5015<mark>auto refractor</mark>.

Foreaseofclassificationofglaucoma,thefollowing criteria were used based on cup discratioandmeandeviation:

i) Mildglaucoma:CupDiscRatio0.5–0.6andorMeanDeviation≤ -6dB
ii) Moderateglaucoma:CupDiscRatio0.7–0.8andorMeanDeviation>-6to-12dB
iii) Severeglaucoma:CupDiscRatio0.9–1.0andorMeanDeviation>-12dB

3. RESULTSANDDISCUSSION

A total of 340 eyes of 170 glaucoma patients intheeyeclinicand340 eyesof170non-glaucoma patients from the GOPD were studied betweenAugust2009andJune2010.

Thegenderdistributionbyagegroupfortheglaucom aandnon-glaucomapatientsisshownin Table 1.There weremore femalesin bothstudygroups(52.9%intheglaucomagroup,56. 5%inthenonglaucomagroup)thanthemales (47.1% in the glaucoma group, 43.5% inthe non glaucoma group) as shown in Table 1.Thisdifferencewasnotstatisticallysignificant.(p =0.513).Themaletofemaleratiowas1:1.2.

A higher proportion of males with glaucoma wereaged 40 - 49 years (40.0%) compared to 21.1%of females whileasimilarproportion of malesand females among non glaucoma were aged40-49years.

Therewasahigherproportionof glaucomacaseswithhypertension(25.9%compare dto22.9%) but there was no significant difference(p=0.528).Theproportionofglaucoma groupwith history of diabetes was 8.2% compared to2.9% of non glaucoma group and this

differencewasstatisticallysignificant(p=0.034).

Table1.DemographicandclinicalcharacteristicsofglaucomaandnonglaucomagroupsAgegr

oup	Glaucomagroup		Nonglaucomagroup		Bothgroups	
	Male(%)	Female(%)	Male(%)	Female(%)	Male(%)	Female(%)
40-49	32(40.0)	19(21.1)	28(37.8)	34(35.4)	60(39.0)	53(28.5)
50-59	22(27.5)	30(33.3)	27(36.5)	37(38.5)	49(31.8)	67(34.1)
60-69	24(30.0)	26(28.9)	13(17.6)	20(20.9)	37(24.0)	46(25.0)
70andabove	2(2.5)	15(16.7)	6(8.1)	5(5.2)	8(5.2)	20(7.6)

	Glaucomagroup(%)	Nonglaucomagroup(%)	Pvalue
Gender			
Male	80(47.1)	74(43.5)	0.513
Female	90(52.9)	96(56.5)	
Hypertension			
Yes	44(25.9)	39(22.9)	0.528
No	126(74.1)	131(77.1)	
Diabetes			
Yes	14(8.2)	5(2.9)	0.034
No	156(91.8)	195(97.1)	
Familyhistoryofglaucoma			
Yes	38(19.5)	7(4.1)	<0.001
No	132(77.6)	163(95.9)	
Visualacuityinthebettereye			
≥6/18	137(80.5)	156(91.8)	<0.001
6/24-3/60	25(14.7)	14(8.3)	
<3/60	8(4.7)	0(0.0)	
MeanIOP(mmHg)			
Righteye	18.0±7.4	13.3±2.8	<0.001
Lefteye	18.5±8.4	12.9±2.8	<0.001
Botheyes	18.3±7.9	13.1±2.8	<0.001

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Furthercomparisonsrevealedthatapositivefamily history of glaucoma was less common inthenon-glaucomagroup(p<0.001);ahigherproportion of the non-glaucoma group had visualacuity ≥6/18 (p<0.001) and that IOP was lowerinthenonglaucomagroup (p< 0.001) seeTable1.

The commonest diagnosis type among glaucomapatients was POAG, found in 137 cases (80.6%)and NTG was found in 33 cases (19.4%). Thedistribution of diagnoses by gender is shown inTable2.Similarproportionsofmales andfemaleshad POAGand NTG(Table 2).

Table2.Associationbetweengenderanddi agnosisamongglaucomagroup

Diagnosis Gender	POAG	NTG	P value
Male	65(81.3)	15(18.7)	0.847
Female	72(80.0)	18(20.0)	

Therewere nosignificantdifferencesbetweenglaucomaandno nglaucomaintheCCTmeasurements. The mean for both groups was530µmforbotheyes.Thepvaluesforthecompari sons for right and left eyes were 0.620and0.857respectively.

3.1DISCUSSION

A total of 780 eyes were studied - 340 eyes ineachgroup.Thehigherproportionofpatientswith visual acuity better than 6/18 in the non-glaucoma group is not unexpected as the eyes inglaucoma group are more likely to have poorervisionfromthedisease.

Therewasahigherproportionof glaucomacases with self-reported hypertension which wasnotstatisticallysignificant.Theproportionofglau comacaseswithself-reportedhistoryofdiabetes was significantly higher in the glaucomagroup. This finding was also documented in theBarbadosEyeStudy[11]whichfoundthatdiabete s was highly prevalent among glaucomapatients.

The commonest type of glaucoma was POAG,andsimilarproportionsofmalesandfemales hadPOAG and NTG. POAG is the most prevalenttypeofglaucomaaffecting1in100of thegeneralpopulationovertheageof40yearsanditaf fectsbothsexesequally[3].

The meanCCT in the non-glaucomagroup inthis study is 530 ± 0.032µm (Table 3). This islowerthanfindingsinstudiesbyMercieca[12],

(535 ± 38µm) in southern Nigeria, 533.34µm inGhanaians [13], 552 ± 35µm in the EuropeanCaucasiansinSwitzerland[14],548.1µmi nHispanics [15] ,550.4µmin Caucasians [15]and555.6µm in the Chinese [15]. The mean CCT intheglaucomagroupwasalso530±0.037µm.There wasnodifferencebetweenthe twogroups. This value is similar to a study by LaRosa [16] in which he compared CCT of whitesandAfricanAmericansinglaucomaandnongl aucoma population with a mean CCT of 531 ±37µm for the 82 African American in the study.The mean CCT in this study is higher than themean CCT in the study by Aghaian et al. [15] in aglaucoma clinic. The mean CCT was 521µm in107 African Americans who were enrolled in thestudy although a higher mean of the age groupswassaidtobeprobablyresponsibleforthis.H erndon[17]studiedonehundredandnine subjects (184 eyes). Forty-eight patients(74 eyes) had glaucoma, 28 patients (51 eyes) hadocular hypertension, and 33 patients (59 eyes)were normal.TheCCTofglaucomatouseyeswas 554±0.022µmandnormalcontrolwas561 ±0.026µm.TherewasnosignificantdifferenceinCC Tbetweennormalandglaucomatouseyes(P = 0.40). Argus [18] also studied thirty-six patientswithOHTcomparedwith29controlsubjectsa nd 31 patients with glaucoma. The mean CCT inpatients with glaucoma was 557 ± 0.039µm andcontrol subject was 567 ± 0.036 µm. This wasnotstatisticallysignificant.IntheEuropeanglauc omapreventionstudy[19]CCTwasmeasuredineigh thundredfifty-fourof1077ocular hypertensive participants. The mean CCTwas 572.6 ±37.4 µm which is higher than thevalueofthisstudy.Variousotherstudies[1,20,21] haveshownthattherewereno statistically significant differencebetweenglaucomapatientsandcontrols. However,RotterdamstudyfoundCCTwasthinnerin POAGthancontrol[22].

Table4presentscomparisonofmeanCCTbetween POAGandNTG.ThemeanCCTinPOAGpatientswa s531±0.037µmand522±0.027µmamongNTGpatie nts.Although,the CCT was thinner in the NTG patients, it wasnot significant (p = 0.196). This is similar to thestudy by Copt et al. [14] which also revealed athinner CCT in NTG than POAG and there wasno significant difference between normal controlsandPOAG.

Fig. 1 presents mean CCT among glaucoma andnon glaucoma by age group. CCT findings weresignificantlyrelatedtooldage.CCTdecreases
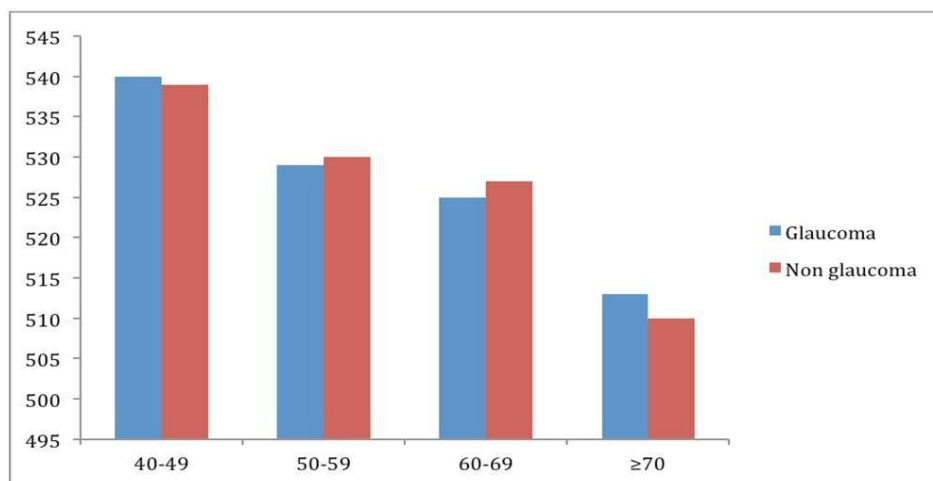
Fig. 1.ComparisonofmeanCCT betweenglaucoma andnon glaucoma cases by age group*ThisfigureshowsthemeanCCTamongglaucomaandnonglaucomagroupbyagegroup.TheCCTdecreasedwithage in both groups*

withincreasingageinbothgroups.However,there have been contradictory reports concerningtherelationship betweenageandCCT.Somestudiesreportednosignificantassociation,[22,23,24] whereas the Barbados Eye Study [11],European glaucoma preventionstudy [19] andothersfoundadefiniteinverserelationship[25,26]. This is probably due to the decrease ininter-fibrillaryspacingintheproteoglycancompositionoftheinter-fibrillarmatrixofthestromamicrostructurewith increasing age.

Table3.Comparisonofcentralcorneathickness between glaucoma and nonglaucomacases

	Glaucoma CCT(µm)	Nonglaucoma CCT(µm)	Pvalue
Righteye	530±0.035	531±0.032	0.620
Lefteye	530±0.037	530±0.032	0.857
Mean(both eyes)	530±0.037	530±0.032	0.731

The CCT was also compared between the types ofglaucoma. There was no significant differencebetweenPOAGandNTGthoughitwashigheramongthosewithPOAG(p= 0.196)

Table4.MeanCCTbetweenthetypesofglaucoma amonggroup

Diagnosis	MeanCCT(µm)	Pvalue
POAG	531±0.037	0.196
NTG	522±0.027	

4. CONCLUSION

Therewasnodifferenceinthemeancentralcornea thickness of glaucoma and non glaucomagroup. The study also confirms that primary openangleglaucomaisthecommonesttypeofglaucoma in our clinic population and that therewas no significant relationship between centralcorneathicknessandspecificopenangleglaucoma.Centralcorneathicknesswasalsoshowntodecreaseswithage.

5. LIMITATION

Dataforkeratometrywasnotcollectedinthis

study.Keratometerwasnotreadilyavailableat thetimeofthestudy.

CONSENT

Informedconsentwasobtainedfromeachpatient.

ETHICALAPPROVAL

StudyapprovalwasobtainedfromtheethicalcommitteeoftheUniversityCollegeHospital,IbadanandtheHeadof GOPD.

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