

Correlation of Central Corneal Thickness with Intra Ocular Pressure Values in Normal, Ocular Hypertensive and Glaucoma Subjects in South Bihar

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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to analyse the CCT trends amongst three study groups: Normal subjects; Primary Open Angle Glaucoma subjects; and Ocular Hypertension subjects.

Methods: The present study was conducted in the Department of Ophthalmology, Narayan Medical College and Hospital, Sasaram, Bihar and total of 120 patients, 40 in each group.

Results: Mean CCT in normal subjects is $555.42 \pm 16.64 \mu\text{m}$, mean CCT in glaucoma subjects is $556.14 \pm 15.35 \mu\text{m}$ and mean CCT in OHTN subjects is $569.15 \pm 31.54 \mu\text{m}$. Applying the described correction factor for corneal thickness, 40% of eyes with ocular hypertension were found to have a corrected IOP of 21mmHg or less.

Conclusion: Increased corneal thickness in ocular hypertension may lead to an overestimation of IOP in 39% of cases. Measurement of central corneal thickness is advisable when the clinical findings do not correlate with the applanation IOP.

Keywords: Glaucoma, Ocular Hypertension, CCT, GAT, IOP.

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Introduction

Central corneal thickness is considered to be an independent risk factor for the development of glaucoma. Elevated IOP is the only modifiable risk factor. The other ocular risk factors are myopia, disc hemorrhage, increased vertical cup-disc ratio and asymmetric cupping. Various studies have shown that significant variation in central corneal thickness (CCT) occur in the normal population. Corneal thickness can vary with ethnicity age gender, refractive status, hormonal status and medications. According to the Ocular Hypertension study [1] in addition to the confounding effect of IOP measurement by Goldman applanation tonometry (GAT), lower central corneal thickness predicts the development of primary open angle glaucoma.

With the rapid development of refractive surgery, central corneal thickness (CCT) has become an important parameter for choosing surgery modality and assessing prognosis. Meanwhile CCT in the diagnosis of glaucoma field also has an important role. [2] Previous studies have revealed the positive relationship between CCT and IOP among adults. Every 10 μm increase in CCT leads to 0.15–1.0 mmHg increase in IOP. [3-5] The CCT as well as IOP is important for assessing the glaucoma

considering the low CCT will lead to the underestimation of IOP and interfere the prognosis of glaucoma. [6]

To date, scarce reference was found to elaborate the relation of CCT and IOP in Chinese school children. This study aims to evaluate the relation of CCT and IOP in Chinese school children aged from 7 to 18 years, and elaborate the effect of gender, age, height, weight and refractive errors on the relation of CCT and IOP. In this study, CCT and IOP were measured using the Tonopachy NT-530P (Nidek, Gamagori, Japan). Tonopachy NT-530P combines a non-contact tonometer and pachymeter into one unit, by which providing the advantage of two types of measurements at one time.⁷ NT-530P automatically measures CCT in each subject using the principle of the Scheimpflug camera system following the same principle as the Pentacam [7,8] and measures IOP like a conventional non-contact tonometer which uses a puff of air to flatten the cornea. It provides IOP and CIOP which is corrected according to CCT at the same time. NT-530P offers a non-invasive CCT and IOP measurement in a single unit and reduces a patient's discomfort with continuously measurements. This

advantage is more suitable for children than Goldman

The aim of the present study was to analyse the CCT trends amongst three study groups: Normal subjects; Primary Open Angle Glaucoma subjects; and Ocular Hypertension subjects.

Materials and Methods

The present study was conducted in the Department of Ophthalmology, Narayan Medical College and Hospital, Sasaram, Bihar. total of 120 patients, 40 in each group.

Eligibility Criteria Inclusion Criteria

Group 1: Normal subjects:

- IOP < 21 mmHg.
- Normal optic discs.
- Angles open on gonioscopy.

Group 2: Ocular hypertensives:

- IOP > 21 mmHg on at least 2 occasions (morning and evening).
- Healthy optic discs with no glaucomatous features.
- No nerve fibre layer defects.
- No glaucomatous field defects.
- Open angles on gonioscopy.

Group 3: Glaucoma subjects:

- IOP prior to treatment > 21 mmHg, with current IOP on treatment < 21 mmHg.

- Glaucomatous optic disc + nerve fibre layer defects.
- Glaucomatous field defects.
- Open angles on gonioscopy.

Exclusion Criteria

- Age < 40 years.
- Evidence of other anterior segment pathology including corneal opacities, keratoconus.
- Previous intraocular or corneal surgery.
- Diabetes mellitus, use of contact lens and any other condition which might affect corneal thickness.
- Any other optic nerve or intracranial disease.
- Corneal oedema.
- Corneal astigmatism > 2D.
- Angle closure glaucoma.
- Patients not willing to give consent.

IOP was measured using Goldmann's Applanation Tonometer and CCT was measured using the ultrasound pachymeter in 80 eyes of 40 normal subjects, 80 eyes of 40 glaucoma patients and 80 eyes of 40 ocular hypertensive patients. A correction factor based on the CCT was applied and corrected IOP values were calculated for the three cohorts. Analysis of Variance and Pearson Correlation Test was used to determine any significant difference in CCT, the correction factors and the CCT adjusted IOPs between the three groups.

Results

Table 1: Comparison of Central Corneal Thickness (CCT) among three groups

	Group	N	Mean	SD	p- value
CCT	Normal	80	555.42	16.64	<0.01
	Glaucoma	80	556.14	15.35	
	OHT	80	569.15	31.54	
p- value		Normal vs Glaucoma - 1.0	Normal vs OHT <0.01	Glaucoma vs OHT <0.01	

Table 2: Comparison of Correction Factor among three groups

	Group	N	Mean	SD	p- value
CF	Normal	80	-0.48	0.84	<0.01
	Glaucoma	80	-0.44	0.80	
	OHT	80	-1.16	1.55	
p- value		Normal vs Glaucoma - 1.0	Normal vs OHT <0.01	Glaucoma vs OHT <0.01	

Table 3: Comparison of Corrected IOP among three groups

	Group	N	Mean	SD	p- value
Corrected IOP	Normal	80	12.78	1.78	<0.01
	Glaucoma	80	16.44	2.68	
	OHT	80	22.82	1.71	
p- value		Normal vs Glaucoma -0.869	Normal vs OHT <0.01	Glaucoma vs OHT <0.01	

Mean CCT in normal subjects is $555.42 \pm 16.64 \mu\text{m}$, mean CCT in glaucoma subjects is $556.14 \pm 15.35 \mu\text{m}$ and mean CCT in OHTN subjects is $569.15 \pm 31.54 \mu\text{m}$. Applying the described correction factor for corneal thickness, 40% of eyes with ocular hypertension were found to have a corrected IOP of 21mmHg or less. Muir et al [12] reported CCT of children increases until 5 years old, then remains stable, which is followed by a slight decrease from the age of 10 to 14 years old. Hussein [13] suggested that CCT increases slowly with time and reaches adult levels until 5 and 9 years old. While Bradfield [14] reported CCT increases from 1 to 11 years old, while the rate of increase steadily decreases, with year-to-year differences steadily decreasing and reaching a plateau after age 11. Sakalar¹⁵ found CCT reaches adult values around 14 years old.

The relationship of CCT and refractive errors is controversial. Li Jinghai [16] reported there is a negative correlation between CCT and refractive error. Chang [17] suggested there is relationship between CCT and the type of refractive errors. Axial myopia refractive corneal thickness decreased according to the increasing of refractive error. However Zhang Shisheng [18] suggested there is a positive correlation between CCT and refractive error. Lin et al [19] suggested there is no significant relationship between CCT and refractive error.

Discussion

Glaucoma is defined as an optic neuropathy characterized by raised Intraocular Pressure (IOP), typical optic nerve head changes and characteristic visual field loss.⁹ Raised IOP is a known causal risk factor for glaucoma, it is the only modifiable risk factor than can be therapeutically manipulated¹⁰, thus making its accurate measurement essential for disease detection and patient follow up. Goldmann applanation tonometry, the current GOLD standard for the measurement of IOP², is based on the Imbert-Fick law. Goldmann observed that when the area applanated was 7.35mm^2 , the surface tension due to the tear film counterbalanced the resistance to indentation of the cornea, thus making it unnecessary to consider the rigidity of the globe and the surface tension of the tear film in applanation tonometry.¹¹

Mean CCT in normal subjects is $555.42 \pm 16.64 \mu\text{m}$, mean CCT in glaucoma subjects is $556.14 \pm 15.35 \mu\text{m}$ and mean CCT in OHTN subjects is $569.15 \pm 31.54 \mu\text{m}$. Applying the described correction factor for corneal thickness, 40% of eyes with ocular hypertension were found to have a corrected IOP of 21mmHg or less.

Conclusion

Increased corneal thickness in ocular hypertension may lead to an overestimation of IOP in 39% of

cases. Measurement of central corneal thickness is advisable when the clinical findings do not correlate with the applanation IOP.

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