Comparison of intraocular pressure and central corneal thickness in non-glaucomatous North-East Indian tribals versus general Indians

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Abstract

Purpose: *To compare the intraocular pressure (IOP) and central corneal thickness (CCT) of non-glaucomatous North-East (NE) Indian tribals and general Indians.*

Materials and methods: *In a prospective, cross-sectional study, the IOP and CCT of non-glaucomatous NE Indian tribals (n = 50) and non-glaucomatous general Indians (n = 50) were compared. Glaucoma was ruled out by history, detailed ocular examinations, and investigations.*

Results: *There was very good correlation between the CCT and IOP values of right and left eyes (p = 0.940 and 0.847, respectively). The difference in the IOP values in the two groups was not statistically significant (p = 0.312 for Oculus Dexter [OD], p = 0.400 for Oculus Sinister [OS]). Similarly, the difference in the CCT values in the two groups was not statistically significant (p = 0.736 for OD and 0.613 for OS). The mean CCT and IOP OD for the whole population was 530.50 ± 35.42 µm and 13.80 ± 2.760 mmHg, respectively. By linear regression analysis, the IOP OD of the whole population had good correlation with CCT OD of the whole population (adjusted r2 = 0.084, p = 0.002), but not with age (adjusted r2=0.000, p=0.314) and sex (adjusted r2 = 0.010, p = 0.163). Similarly, CCT OD for the whole population did not have good correlation with age (adjusted r2 = -0.009, p = 0.762) and sex (adjusted r2 = -0.007, p = 0.603).*

Conclusions: *In this study of individuals with normal corneas and without glaucoma, no racial variation was found in the CCT and IOP values of the two groups. The IOP OD of whole population had good correlation with CCT, but not with age and sex. There was good correlation between OD and OS values of IOP and CCT.*

Keywords: *central corneal thickness (CCT), intraocular pressure (IOP), general Indians, non-glaucomatous, North-East Indians*

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Introduction

Increased intraocular pressure (IOP) is a well-recognised risk factor for glaucoma and central corneal thickness (CCT) is known to have a definite influence on IOP. Studies have shown that ethnic variation exists in IOP and CCT values.[1-5] These variations have been studied in Caucasians, African Americans and Asians. Aghaian *et al.* found that the Japanese have thinner corneas than the Chinese and the Filipinos.[2] They concluded that differences in CCT may exist among different Asian subgroups. As per Foster *et al.*, variation in CCT is a significant source of variation in IOP measurements between individuals.[4]

It is important to find the variations in IOP and CCT in ethnic groups, otherwise we may falsely diagnose cases of normal tension glaucoma, ocular hypertension, and glaucoma or miss them depending on the CCT.

Some population-based studies have been carried out determining the IOP and CCT in East and South-East Asia. Chua *et al.* carried out a study to assess the ethnic variations in IOP and CCT using uniform study designs among three different Asian ethnic groups. They confirmed the presence of ethnic variation in IOP and CCT among Asian subgroups. They highlighted the need to study Asian subgroups individually and not in aggregate in future studies.[5]

There have also been studies reporting the IOP and CCT in general Indians.[6-9] However, North-East (NE) Indians are ethnically distinct and different from the general Indian population. To the best of our knowledge, there has been to-date no study done to determine IOP and CCT in non-glaucomatous NE tribals and compare these parameters with those of non-glaucomatous general Indians.

Therefore, we wanted to determine if there exists any ethnic variation in the CCT and IOP values between these two groups. If there is a difference, using the established normative values of IOP and CCTs will lead to inaccurate measurements in NE Indians, which in turn may lead to misdiagnosis of glaucoma in NE Indians.

Materials and methods

This was a prospective, cross-sectional study conducted in the department of Ophthalmology of a medical college of NE India. Permission was obtained from the Institute Ethics Committee for the study. Informed written consent was taken from every patient. We adhered to the tenets of the Declaration of Helsinki.

The medical institute shares its location with the headquarters of many central government agencies, such as Eastern Air Command, Border Security Forces, Geological Society of India, a central university, etc. Therefore, many of these central government employees living in and around the medical college come for regular medical check-ups here. Being a regional institute, it caters to people from all of the North- Eastern states. Two to three eligible patients from each state were

enrolled in this study. Hence, the study population represents the entire Indian population.

Glaucoma was ruled out first by family history, detailed ocular examination, Humphrey visual field analyzer 30-2, IOP by Goldmann applanation tonometer (GAT), and gonioscopy. Only non-glaucomatous, consecutive, adult (> 40 years) patients attending the Outpatient Department of Ophthalmology and willing to take part were included in the study. Since these were consecutive patients taken each day of the week, there was minimal or negligible chance of selection bias. The study was conducted for a period of three months. These subjects were divided into two groups of 50 individuals each. Group 1 consisted of the non-glaucomatous general Indians and Group 2 consisted of the ethnic tribals of NE India visiting our tertiary care centre. Equal representation was ensured from all the states of NE India for the NE Indians and other states for the general Indians. Inclusion criteria were non-glaucomatous patients with both eyes normal. Exclusion criteria were any corneal patholoies, corneal or intraocular surgery, recent contact lens use and poor fixation of eyes, patients with glaucoma suspect or glaucoma, myopia > -2 dioptres, and one eyed. IOP and CCT were recorded by a single examiner. Measurements were done in the morning hours only, between 9 AM and 12 PM. IOP was measured first followed by CCT. Proparacaine 0.5% (Carecain,Sunways P Ltd., Mumbai, India) eye drops were instilled in both eyes twice in a 5-minute interval. IOP was measured by GAT (AT 900, CE 1250, Haag-Streit International) in both eyes. The right eye was measured first followed by the left eye. A drop of proparacaine 0.5% solution was instilled once again after 15 minutes. CCT was then measured with ultrasonic pachymeter (Sonomed, Micropach, 200P+, USA). Measurements were done with the patient looking straight and fixating at a distant target. Three consecutive error-free measurements were taken in each eye. The average of these three measurements was taken.

Statistical analysis

Clinical characteristics were found by descriptive statistics. Comparisons of parameters between the two groups were done using the t-test. Correlations of IOP and CCT with other parameters individually were done using Pearson correlation coefficients. Regression analysis was performed to see the correlation of IOP and CCT with age and sex. A 5% level of significance was adopted. Therefore, a P-value of < 0.05 was considered statistically significant. Statistical analysis was performed using the SPSS software package (SPSS for Windows, version 22.0; SPSS, Inc., Chicago, IL, USA).

Results

There were 50 participants in each group. The profile of participants and the distribution of IOP and CCT values by age are shown in Table 1. The two groups were well matched by age (p = 0.816) and sex (p = 0.692) (Table 1). The IOP and CCT characteristics of the two groups are shown in Table 2. The differences in IOP values between the two groups were not statistically significant (p = 0.312 for OD, p = 0.400 for OS) (Table 2). Similarly, the difference in CCT values between the two groups was not statistically significant (p = 0.736 for OD and 0.613 for OS) (Table 2). The difference in IOP and CCT values when compared by gender was also not statistically significant (Table 3).

Table 1. Profile of participants and the distribution of IOP and CCT values by age

Groups	Mean Age	SD	Range	P value	Males %	Females %	P value
1	38.94	10	20-60	0.816	56	44	0.692
2	39.52	14.4	18-74		52	48	

Table 2. The IOP and CCT characteristics of the two groups

Parameters	Groups	Mean	SD	Range	P value
IOP OD mmHg	1	14.08	3.023	9 – 20	0.312
	2	13.52	2.46	10-19	
IOP OS mmHg	1	13.84	2.7	9-20	0.400
	2	13.4	2.5	9-19	
CCT OD µm	1	529.3	35.81	465.00-618.80	0.736
	2	531.7	35.35	464.40-607.40	
CCT OS µm	1	532.09	38.7	456.20-632.20	0.613
	2	528.5	32	474.00-606.00	

There was very good correlation between the CCT values of right and left eyes (P = 0.940) (Fig. 1). Similarly, there was good correlation between the IOP values of right and left eyes of the whole population (P = 0.847). The Pearson correlation coefficients of IOP and CCT of right eyes of the two groups with other parameters are shown in Table 4.

The mean CCT OD of the whole group was 530.50 ± 35.42µm and the mean IOP OD of the whole population was 13.80 ± 2.760 mmHg. The CCT OD in the whole population had a normal distribution (Fig. 2). Similarly, the IOP OD in the whole population had a normal distribution.

Table 3. Difference in the IOP and CCT values when compared by gender

Parameters	Sex	Mean	SD	P value
IOP OD mmHg	Male	13.44	2.82	0.163
	Female	14.22	2.64	
IOP OS mmHg	Male	13.46	2.70	0.515
	Female	13.80	2.50	
CCT OD μm	Male	528.79	35.70	0.603
	Female	532.50	35.38	
CCT OS μm	Male	526.88	35.35	0.298
	Female	534.30	35.34	

Table 4. Pearson Correlation Coefficients (P values) of IOP with other parameters

		IOP OS	CCT OD	CCT OS	Age	Sex
IOP OD	Group 1	0.855 (0.000)	0.302 (0.033)	0.317 (0.025)	0.917 (0.170)	0.03 (0.835)
	Group 2	0.839 (0.000)	0.326 (0.021)	0.311 (0.028)	0.034 (0.816)	0.288 (0.043)

		CCT OS	IOP OD	IOP OS	Age	Sex
CCT OD	Group 1	0.963 (0.000)	0.302 (0.033)	0.241 (0.091)	-0.044 (0.761)	0.048 (0.742)
	Group 2	0.929 (0.000)	0.326 (0.021)	0.323 (0.022)	0.083 (0.568)	0.055 (0.705)

		IOP OD	CCT OD	CCT OS	Age	Sex
IOP OS	Group 1	0.867 (0.000)	0.327 (0.268)	-0.359 (0.231)	0.018 (0.825)	-0.021 (0.797)
	Group 2	0.846 (0.000)	-0.143 (0.519)	0.213 (0.337)	-0.354 (0.725)	-0.089 (0.299)

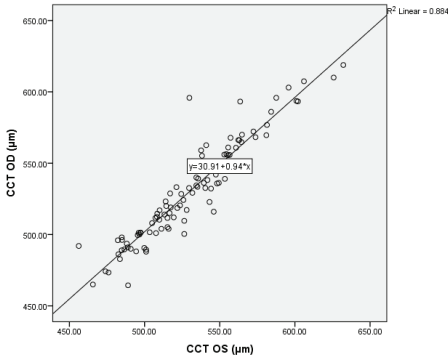|		CCT OD	IOP OD	IOP OS	Age	Sex
CCT OS	Group 1	0.949 (0.000)	0.109 (0.161)	-0.091 (0.231)	-0.011 (0.779)	0.061 (0.123)
	Group 2	0.919 (0.000)	-0.089 (0.397)	0.098 (0.337)	0.046 (0.399)	0.059 (0.306)

Fig. 1. Correlation between the CCT values of right and left eyes.
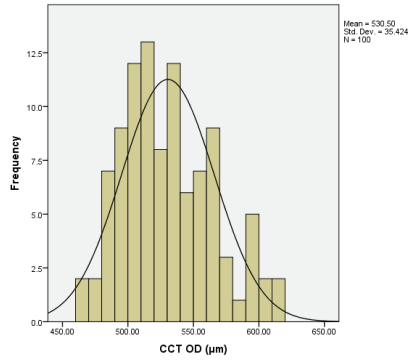

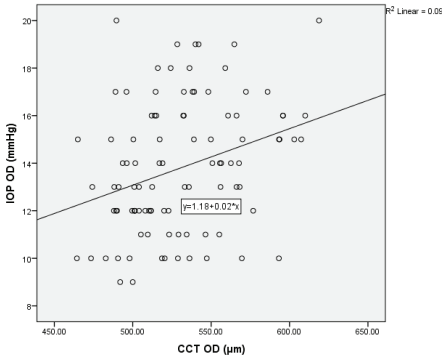Fig. 2. Distribution of CCT OD in the whole population.

Fig. 3. Correlation of IOP OD of the whole population with CCT OD of whole population by linear regression.
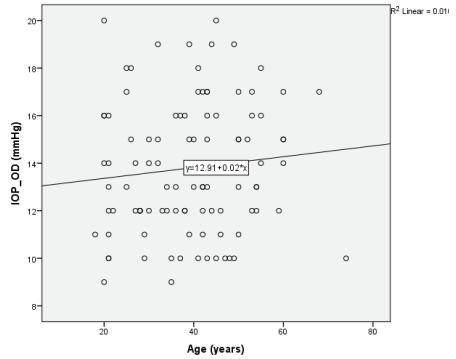

Fig. 4. Correlation of IOP OD of the whole population with age of whole population by linear regression.

By linear regression analysis, the IOP OD of the whole population had good correlation with CCT OD of the whole the population (adjusted $r^2 = 0.084$, P = 0.002) (Fig. 3), but not with age (adjusted $r2 = 0.000$, p = 0.314) (Fig. 4) and sex (adjusted $r^2 = 0.010$, p = 0.163). Similarly, CCT OD of the whole population did not have good correlation with age (adjusted $r2 = -0.009$, p = 0.762) and sex (adjusted $r^2 = -0.007$, p = 0.603).

Discussion

CCT and IOP measurements are part and parcel of any glaucoma work up. The ethnic variation in CCT and IOP has been established in earlier studies. In our study, we have attempted to compare IOP and CCT in general Indians and ethnic

tribals of NE Indians, since no such study is available to date. We did not find any statistically significant difference in mean CCT and IOP between t general Indians and NE Indians.

Mean OD CCT of the whole group was 530.50 ± 35.42µm. It was less than the mean CCT (in µm) of Caucasians (550.4 +/-3.2), Chinese (555.6 ± 3.4), Filipinos (550.6 ± 3.8), Hispanics (548.1 ± 3.6), Asians (548.4 ± 2.8);[2] Caucasians (552.59 ± 34.48), African Americans (535.46 ± 33.39), Asians (549.79 ± 32.3), Hispanics (551.10 ± 35.54),[3] whites in the Barbados study (545.2 ± 45),[10] whites in the Baltimore study (558.0 ± 34.5),[11] whites in the Rotterdam study (537.4),[12] Latinos in the Los Angeles study (546.9 ± 33.5),[13] Northern Chinese (556.2 ± 33.1),[14] Southern Chinese (541.4 ± 31.4),[15] Singaporean Indian (540.4 ± 33.6) and Singaporean Malay (540.9 ± 33.6).[5]

It was close to the mean CCT of Koreans (530.9 ± 31.5),[16] Japanese (531.7 ± 4.1),[2] and non-glaucomatous African Americans (533.80 ± 33.9).[17] However, it was more than the mean CCTs (in µm) obtained from the other Indian studies: the Chennai Glaucoma Study (511.4 ± 33.5), the Central India Study (514 ± 33), and the glaucoma study in a rural south Indian population (505.93 ± 31.11).[6-8] It was also more than the mean CCT for African-Americans (521.0 ± 3.9),[2] blacks in the Barbados Eye Study (529.8 ± 37.7),[10] ophthalmologically normal Mongolians (495 ± 32 OD, 514 ± 32 OS),[4] ophthalmologically normal Japanese (517.5 ± 29.8),[18] and Burmese (521.9 ± 33.3).[19]

In this study, we also calculated the mean IOP and CCT of the entire Indian population (whole group). Mean IOP in the whole population OD was 13.80 ± 2.76 mmHg. These values were comparable to the values obtained from population-based studies from India: the Central India Eye and Medical Study (13.6 ± 3.4), the glaucoma study in a rural south Indian population (14.29 ± 3.32), and Aravind Comprehensive Eye Survey (14.4 ± 3.7).[7-9] It was also similar to Caucasians (14.32 ± 2.93) and African Americans (16.12 ± 3.27),[3] Koreans (14.1 ± 2.7),[20] Japanese (14.5 ± 2.5),[21] Singaporean Chinese (15.6 ± 3.8),[4] Singaporean Indians (15.8 ± 2.9), Singaporean Chinese (14.3 ± 3.1), and Singaporean Malay (15.3 ± 3.7).[5]

Our study used ultrasonic pachymetry. The difference in mean CCT between males and females was not statistically significant. This is in agreement with some of the previous studies,[2,4,10,12,19] but in contrast to some other studies.[6,7,13,18,22]

Our study was limited by the fact that the samples were not very large and were only hospital-based; therefore, there may be sampling bias. Although NE Indians are distinctly different from general Indians, they are not strictly homogenous in nature.

To conclude, in this study in individuals with normal corneas and without glaucoma, no racial variation was found in CCT and IOP values between the two groups. The IOP OD of the whole population had good correlation with CCT, but

not with age and sex. There was good correlation between OD and OS values of IOP and CCT.

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