

Factors Affecting the Central Corneal Thickness in Nepalese Population

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ABSTRACT

Background: Intra Ocular Pressure (IOP) is an important parameter for the detection and monitoring of glaucoma. Central corneal thickness (CCT) can influence the IOP estimated with Goldmann tonometry. A thick cornea overestimates the IOP and thin underestimates it. So, decreased CCT may lead to underdiagnosis and undertreatment of glaucoma and increased CCT may lead to overdiagnosis and overtreatment of glaucoma. The aim of the study is to identify the factors affecting the CCT in Nepalese population.

Methods: A hospital based cross-sectional study which enrolled 152 subjects from period of January 2009 to May 2010. All subjects underwent ophthalmological examinations. CCT was measured with ultrasonic pachymeter and intraocular pressure was measured with Goldmann applanation tonometer.

Results: The mean±SD CCT of right and left eye was 538±32 and 540±30µm respectively. CCT decreased with increasing age. Age and intra ocular pressure was significantly correlated with CCT. There was no significant correlation of gender and ethnicity with CCT.

Conclusion: CCT decreased with increasing age. CCT was significantly correlated with age and intra ocular pressure but not with gender and ethnicity.

Keywords: Nepalese; central corneal thickness; ultrasound pachymeter

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Background:

Glaucoma is the leading cause of irreversible blindness in both developed and developing countries. It is a major eye problem leading to blindness in Nepal. According to National Blindness Survey (NBS) 1981,¹ it is the fourth major cause of blindness, the first three being cataract, iatrogenic sequelae of cataract and retinal diseases. A thick cornea causes a falsely high measurement if the thickness is due to increased collagen fibrils.² Patient with normal tension glaucoma may have thinner cornea than normal resulting in under

estimation of their intra ocular pressure and patients with thicker cornea can be misdiagnosed as ocular hypertension.² Imbert-Fick law,^{2,3} which presupposes that for a normal thickness cornea (520µm by optical pachymetry) and a 3.06mm diameter plunger, the surface tension of tear film (which pulls on the plunger) will approximately offset the corneal rigidity (which pushes back on the plunger), allowing intra ocular pressure to be measured with reasonably accuracy. The effect of central corneal thickness (CCT) as a confounding factor affecting the accuracy of intra ocular pressure

as measured by Goldmann applanation tonometry appears to be small and usually not clinically relevant. However, when CCT is markedly different from the normal, this factor should be taken into account. It is for this reason that during screening of glaucoma, CCT, should be considered in trying to decide which of these individuals require close observation or the initiation of therapy before definite damage occurs. Apart from the reasons why corneal thickness plays a role in glaucoma management, it has also been shown that lower CCT is significantly associated with worsened advanced glaucoma, worsened visual field, increased vertical and horizontal cup-disc ratios, and increased number of glaucoma medications.⁴

Methods:

This is a hospital based cross-sectional study conducted from January 2009 – May 2010 at Manipal Teaching Hospital, Pokhara. A total of 152 subjects having clear cornea were included in this study. A brief ocular history of participants was taken. Patients had undergone detailed ophthalmological examination. Visual acuity for distance and near was recorded with self – illuminating standard Snellen’s letter chart or E – chart for illiterates at a distance of 6m and 40 cm respectively.

Detailed slit – lamp evaluation was done for every subject under Haag streit 900 slit lamp. Evaluation of optic disc and posterior pole was done with the help of direct ophthalmoscope with Heine beta 200 using white light, using red free light. Also slit lamp evaluation with +90D was done. Intraocular pressure was recorded with Goldmann applanation tonometer. Gonioscopic examination was done. Central corneal thickness was measured with an ultrasonic pachymeter (Model no. Palm Scan TM AP 2000). After applying topical local anesthesia, the pachymeter tip was placed in the center of cornea in the mid-pupillary axis and 4 pachymetry readings were recorded and average value was obtained. All measurements were made between 8:30 am to 4:30 pm.

Results:

In our study, age of study population ranges from 20 to 90 years, 45% were females and 55% were males. The maximum cases were Gurung followed by Newar, Magar, Brahmin and Chhetri. The mean±SD CCT of right and left eye was 538±32 and 540±30µm respectively. The mean±SD intra ocular pressure of right and left eye was 12.39±2.34 and 12.48±2.28mmHg. Mean CCT was more in < 40years group, males and in Magar (Table1).

Table 1: Mean CCT of different variables

| Variables | CCT (µm) | | |
|-------------|------------------|---------------|---------------|
| | RE mean±SD | LE mean±SD | |
| Age (Years) | <40 [n=26 (17%)] | 554.0±31.4* | 554.9±29.7* |
| | >40 [n=126(83%)] | 535.5±32.4* | 537.5±30.2* |
| Gender | Male | 540.5±31.4* | 543.3±30.6* |
| | Female | 535.4±34.5* | 537.3±30.7* |
| Ethnicity | Brahmin | 541.7±30.1** | 547.8±30.1** |
| | Chhetri | 526.4±39.9** | 527.0±34.7** |
| | Gurung | 532.9±28.7** | 535.9±24.6** |
| | Magar | 547.9±32.5** | 547.73±31.2** |
| | Newar | 545.6±33.9** | 546.0±34.1** |
| | Others | 530.8±30.7** | 531.64±26.5** |

* The difference in CCT is not significant (z – test)

** The difference in CCT is not significant (ANOVA)

Table 2 showed age and intra ocular pressure was significantly correlated with CCT at 0.01 level (2 – tailed). There was no significant correlation of gender and ethnicity with CCT at 5% level (2 – tailed).

Table 2: Correlation of different variables with CCT.

| Variables | r | Sig. | |
|-----------|----------|--------|---------|
| Age | CCT (RE) | -0.386 | 0.000** |
| | CCT (LE) | -0.366 | 0.000** |
| Gender | CCT (RE) | 0.092 | 0.257 |
| | CCT (LE) | 0.111 | 0.175 |
| Ethnicity | CCT (RE) | 0.047 | 0.562 |
| | CCT (LE) | 0.000 | 0.996 |

** Correlation is significant at the 0.01 level (2 – tailed)

The Karl Pearson’s coefficient of correlation between CCT and IOP of right eye and left eye was 0.404 and 0.295 respectively. Both are significant at 0.01 levels (2 – tailed) (Table 3).

TABLE 3: Correlation of IOP and CCT

| | CCT (RE) | CCT (LE) |
|----------|----------|----------|
| IOP (RE) | 0.404** | |
| IOP (LE) | | 0.295** |

** Correlation is significant at the 0.01 level (2 – tailed)

Figure 1 and 2 illustrate scatter diagram of CCT and IOP in study groups, showing a low positive relationship between CCT (RE), IOP (RE), CCT (LE) and IOP (LE).

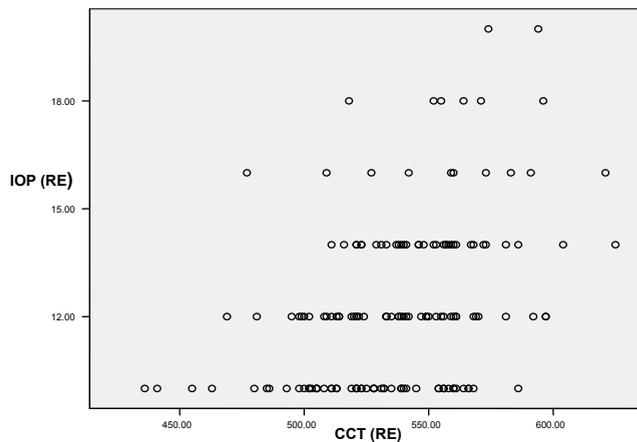


Figure 1: Scatter diagram of IOP against CCT (RE)

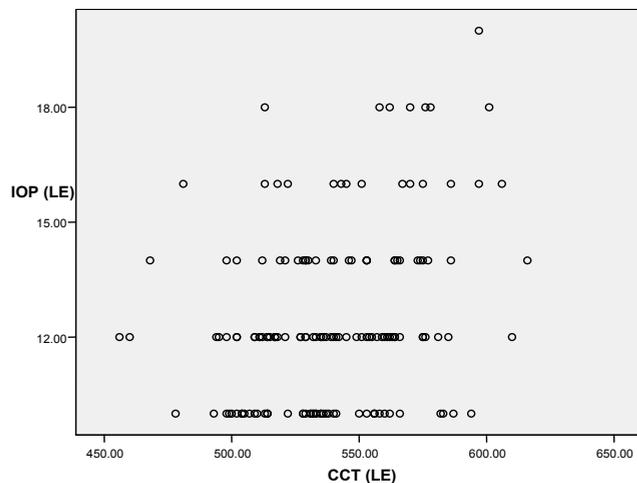


Figure 2: Scatter diagram of IOP against CCT (LE)

DISCUSSION:

Intra ocular pressure is an important risk factor that has a significant influence in the diagnosis and follow-up of glaucoma. The measurement of CCT aids in clinical assessment of glaucoma,⁵ increasing evidence suggests that CCT not only influences intra ocular pressure level but also predicts the risk of glaucomatous neuropathy. Goldmann and Schmidt had predicted in their original work that the intra ocular pressure reading theoretically could be affected by CCT.⁶ In our study mean CCT in right eye and in left eye was 538.2 ± 32.8 and 540.0 ± 30.6 μm respectively.

1. Age Groups

The maximum number of participants were found between 40 – 69 years (71%). 17% of them were less than 40 years of age and 83% were of more than 40 years (Table 1). This could easily be explained by the life expectancy of the Nepalese population. In our study mean CCT was found to be more in <40 years of age than that of >40 years (Table

1). Our study has similarity with the study done by Sora Hobn et al. which found thin CCT is in older individual.^{7,8} We noted negative significant relationship between age and CCT of (RE), CCT of (LE) at 0.01 level (2 – tailed) (Table 2). Statistically significant negative correlation between age and CCT was shown by European Glaucoma Prevention study group and K Kawase et al.⁹ Similarly Elsa Aghaian et al also found a statistically significant inverse relationship.^{10,11} Some studies reported CCT and age as contradictory. On the other hand there are some studies which have observed no significant association between those factors.^{12,13}

2. Gender distribution

In our study, 45% were females and 55% males. This could be because of more attention being paid for the health of males. In Nepal, we have male dominating society and males are given much more importance in general. Our study is different from the study done by Sah RP et al.¹⁴ and Lingam Vijaya et al,¹⁵ who observed female participants more than male participants. Mean CCT was more in males in our study (Table 1). Here a positive insignificant correlation between gender and corneal thickness was noted (Table 2).

Our study has similarity with the study done by Mitsugu Shimmyo et al who observed CCT of males ($553.3\mu\text{m}$) to be thicker than of females ($548.0\mu\text{m}$)¹⁶ Similarly European Glaucoma Prevention study Group also noted greater CCT in males than in females.⁹ Danial HW ‘The Singapore Malay Eye Study’ observed that there was no difference in mean CCT between male ($540.7\mu\text{m}$) & female ($541.6\mu\text{m}$)⁵ while Rodrigo J Torres et al. observed CCT was greater in AI/AN females than in AI/AN males ($557.6, 550.1\mu\text{m}$ respectively).¹⁷

3. Ethnicity

In our study Gurungs were 26%, Newars 20%, Magars 17%, Brahmins 13%, Chhetris 13% and others were 11%. Mean CCT was more in Magars (Table 1). Ethnicity was not significantly correlated with CCT (Table 2).

4. Central corneal thickness and intra ocular pressure

Correlation between CCT and IOP of right eye was 0.404; similarly correlation between CCT and intra ocular pressure of left eye was 0.295. Both are significant at 0.01 level (2-tailed) (Table 3). This study has similarity with studies by K Kawase et al, who showed that intra ocular pressure was significantly associated with CCT in adult Japanese population.^{18,19} There are few studies which have shown no correlation between CCT and intraocular pressure. M. Cristina leska et al. were not able to correlate baseline intra ocular pressure with CCT.¹⁹ Similarly in studies done in

Black and ethnic Chinese, no positive correlation was seen between CCT and intra ocular pressure.^{20,21} Barbodos eye study also didn't find significant correlation between CCT and intra ocular pressure.²²

Conclusion:

As reported in many previous studies we have also seen a negative significant correlation of age with CCT. We have noted a positive, significant correlation of CCT with IOP but not with gender or ethnicity.

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