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The Association of Central corneal thickness with Intra- ocular Pressure of human being in AL Sadder Medical city

Sabah Abdulmohsin Ali Almashref[1], Qusay Hussein Ali Al-Maleki[2*], Kassim Abd Abd Ali Alshamkie[2],

1 Department of Ophthalmology, AL-Shifaa General Hospital, Basrah Health Directorate, Ministry of Health and Environment, Basrah, Iraq

2 Department of Ophthalmology, AL-Mawani Teaching Hospital, Basrah Health Directorate, Ministry of Health and Environment, Basrah, Iraq

Corresponding author:

Qusay Hussein Ali Al-Maleki

Department of Ophthalmology, AL-Mawani Teaching Hospital, Basrah Health Directorate, Ministry of Health and Environment, Basrah, Iraq

Email: medicalresearch82@yahoo.com

Zip code: 61001

Goldmann applanation tonometery, (GAT); Intraocular pressure, (IOP); Corrected intraocular pressure (CIOP); Corrected factors,(CF); Central corneal thickness, (CCT); Right Central corneal thickness(RT.CCT); Left Central corneal thickness (LT.CCT)

Abstract

Between intraocular pressure and central corneal thickness of 200 eye of 100 subjects consisting of males (n=53) (53%), and females (n=47) (47%) within (18-75) years with, mean age of (47.6±12.961) years. For all the subjects, mean corrected IOP (18.44±6.4575) mmHg. Mean CCT (524.775±41.796) μm. Mean corrected IOP for males (18.3113±6.48503) mmHg, and for females mean corrected IOP (18.5851±6.47123) mmHg. The CCT for males (525.5283±45.39594) μm and for females (523.92536±37.56521) μm. The study was shown that there is no liner relationship between IOP and CCT and the relation is inverse and not significant. It was also shown that neither CCT nor IOP was influenced by gender. And there was no difference between right and left eye. There was strong positive correlation between RT.CCT and LT.CCT. The slight association between CCT and age indicated a reduction of CCT with increasing age.

Keyword: **Intra- ocular Pressure; Central corneal thickness; Corrected factors**; **Goldmann applanation tonometery**

Introduction

Increased IOP is considered the main risk factor for glaucoma. The most exact technique to measure IOP is direct cannulation of the anterior chamber with a needle connected to a manometer [1, 2]. Such a procedure is only possible in animals for experimental investigation. In humans only a non-invasive device can be used defined as tonometry [3]. This involves applying a force against the cornea that produces a distortion of the globe. However, central corneal thickness (CCT) in a population varies widely and ranges from 440 to 640 μm [4]. Due to this wide variation, the measured IOP is often erroneous, particularly in the eyes in which the CCT is significantly different when compared with the mean CCT of the population [1, 5]. As optical and later ultrasonic pachymeters came into widespread use, it became clear that corneal thickness does indeed have a positive correlation with IOP as measured by Goldmann applanation tonometry [6, 7]. Ehlers et al observed that IOP is measured erroneously higher in eyes with CCT more than normal, whereas the IOP is measured erroneously lower in eyes with CCT less than normal [1]. Electronic pachymetry became popular since the start of the refractive surgery. With the introduction of ultrasonic pachymeters, it became apparent that variations in corneal thickness are much more widespread than once believed [8]. Doughty and Zaman [9], reported that the mean central corneal thickness (CCT) in normal eyes was 534μm while for ultrasonic pachymetry, the mean CCT was 544μm [8,9].

The average central corneal thickness measures from 535 - 565μm, although ethnic differences are likely [10].

Supplementary: Correction values for IOPs based on CCT. Corrections derived from data from Ehlers, et al., (1975), Stodtmeister (1998), and Doughtry and Zaman (2000).

CCT micron	IOP mmhg	CCT micron	IOP mmhg
445	7	545	0
455	6	555	-1
465	6	565	-1
475	5	575	-2
485	4	585	-3
495	4	595	-4
505	3	605	-4
515	2	615	-5
525	1	625	-6

535	1	635	-6
		645	-7

Other IOP correction formulae beyond Ehlers formula have also been developed. Below, is a simplified version of the Orssengo-Pye formula that has been advocated by James Tsai and Stephen Trokel at Columbia University [11, 29, 30].

Corrected IOP = Measured IOP – (CCT-545)/50 x 2.5 mm Hg

This simplified formula instructs the clinician to correct IOP by 1.0 mm Hg for every 20 microns of CCT variation from the 545 standard.

A Problem With CCT-Based Correction - Corneal Elasticity

In addition to CCT, Goldmann also observed that a range of other corneal properties could cause GAT to be inaccurate. Current investigations have validated Goldmann's observations and have suggested that corneal elasticity rather than CCT seems to be a principle cause of GAT error [1, 25].

- Low CCT
- Edematous corneas – regardless of CCT
- Children under age 7 – regardless of CCT
- High corneal diameter
- History of any corneal refractive surgery – regardless of CCT
- Endothelial dystrophies
- Epithelial dystrophies [15]

Other Sources of errors

1. Inappropriate fluorescein pattern. Excessive fluorescein will be overestimated, whereas insufficient fluorescein will lOP underestimation
2. Pressure on the globe from the examiner's fingers result in an artificially high reading.
3. Astigmatism, if significant, may give distorted mires. If over three dioptres, the average reading of two can be taken.
4. Incorrect calibration of the tonometer can result in a false reading.
5. Wide pulse pressure. It is normal for there to be a small oscillation in IOP in time with the rhythm of ocular perfusion.
6. Repeated readings over a short period will often be associated with a slight fall in IOP.
7. Other factors that may be associated with overestimation of IOP include a tight collar and breath holding, both of which obstruct venous return [17].

The aim of this study was to investigate the variation of central corneal thickness with intraocular pressure and to analyze any change in management decisions based on a CCT measurement being revealed.

Methods

A sample size of two hundred eye of hundred patient made up of 52% male and 48% female were IOP and CCT measured in different age group. The subjects were within (18-75) years old. The data were collected and classified according to central corneal thickness (CCT) and intraocular pressure readings by the Goldmann applanation tonometer. The mean IOP of both male and female, the mean CCT of both male and female and age of all patients. The data also classified according to the laterality of right and left eye.

Pachymetry a specular microscop (EM3000 SPECULAR MICROSCOPE) was used to measure CCT (μm).

Measured CCT for the subject was taken as the average of five different readings and recorded in microns (μm).

The intraocular pressure (IOP) was assessed with the Inami slit-lamp biomicroscope mounted Goldmann applanation tonomete r(GAT) throughout the study after sterilizing the tonometer probe with hydrogen peroxide and the cornea was anaesthetized by applying adrop of Alcaine 0.5% (proparacaine hydrochloride eye drop) and staining the eye with wetted fluorescein strip.Three consecutive readings are taken and the average recorded as measured IOP (mIOP) in mmHg Then Ehlers formula was used for correction the IOP according the table.

Note that the IOP measurements were taken 10 minutes after specular microscop. All measurements of CCT and IOP were taken between 9.am. and 12 morning to avoid diurnal variation.

Results

A total of (200) eye of (100) subjects consisting of males (n=53) (53%) and females (n=47) (47%) within (18-75) years with mean age of (47.6±12.96) years were used for this study.

For all the subjects, mean corrected IOP (18.44±6.45) mmHg. Mean CCT (524.775±41.79) pm. Mean corrected IOP for males (18.3113±6.48503) mmHg for females mean (18.5851±6.47123) mmHg. The CCT for males (525.5283±45.39594) pm for females (523.9253±37.56521) pm.

Table1: Descriptive statistics of the sample

	Minimum	**Maximum**	**Mean**
Age	18	75	47.6±12.96

RCIOP	5	43	17.99±6.42
LCIOP	6	44	18.89±6.5
RCCT	351	675	530.04±43.58
LCCT	416	623	519.51±40.01

Table 2: Age distribution of the sample

Age group	No.	%
<40	23	23
40-49	26	26
50-59	27	27
60-69	19	19
70	5	5
Total	100	100

There was very weak negative correlation with no statistical significance between CCT µm and age (r= – 0.023, p= 0.13), as shown in figure:1

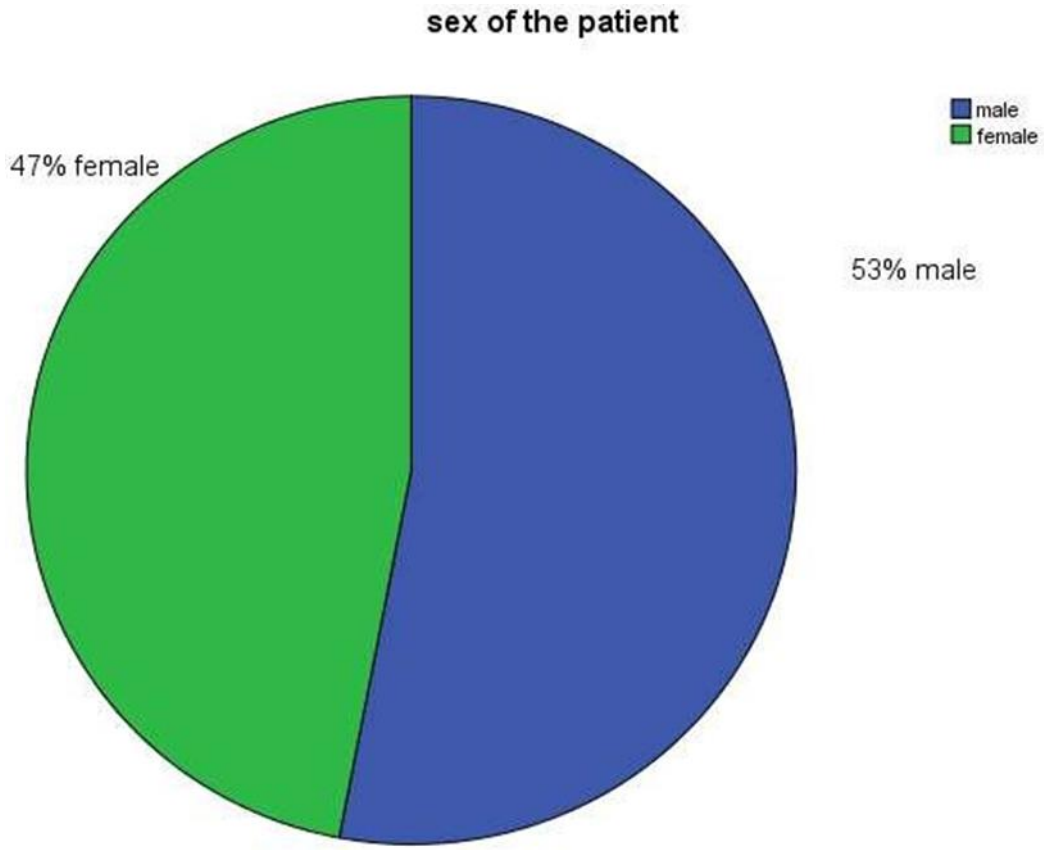

Figure 1. sex of patients.

Male

Table 3: Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	SD
Age	53	55.00	18.00	70.00	47.0000	12.81225
RCIOP	53	35.00	5.00	40.00	17.8868	6.79270
LCIOP	53	29.00	10.00	39.00	18.7358	6.17735
RCCT	53	324.00	351.00	675.00	531.4151	50.33978
LCCT	53	199.00	416.00	615.00	519.6415	40.04521

Females

Table 4: Descriptive Statistics

	N	Minimum	Maximum	Mean	SD
Age	47	18.00	75.00	48.2766	13.23155
RCIOP	47	5.00	43.00	18.1064	6.04416
LCIOP	47	6.00	44.00	19.0638	6.89803
RCCT	47	460.00	624.00	528.4894	34.90787

LCCT	47	434.00	623.00	519.3617	40.402 55

Males

There was very weak negative correlation with no statistical significance between RCCT and RCIOP (r= – 0.12, p= 0.39) as shown in figure: 2

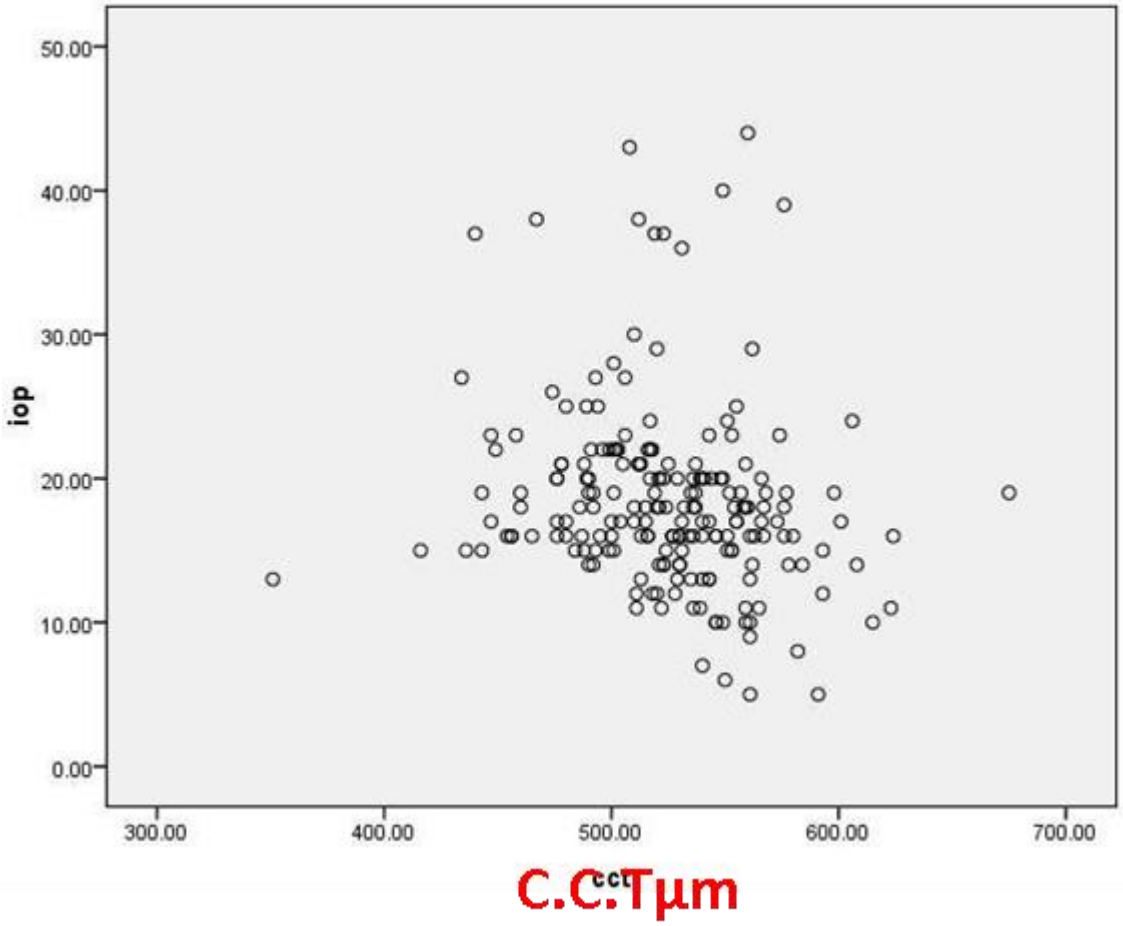

Figure 2: correlation bet. CCT and iop

Females

There was very weak negative correlation with no statistical significance between RCCT and RCIOP (r= – 0. 21, p= 0.158) as shown in figure:3

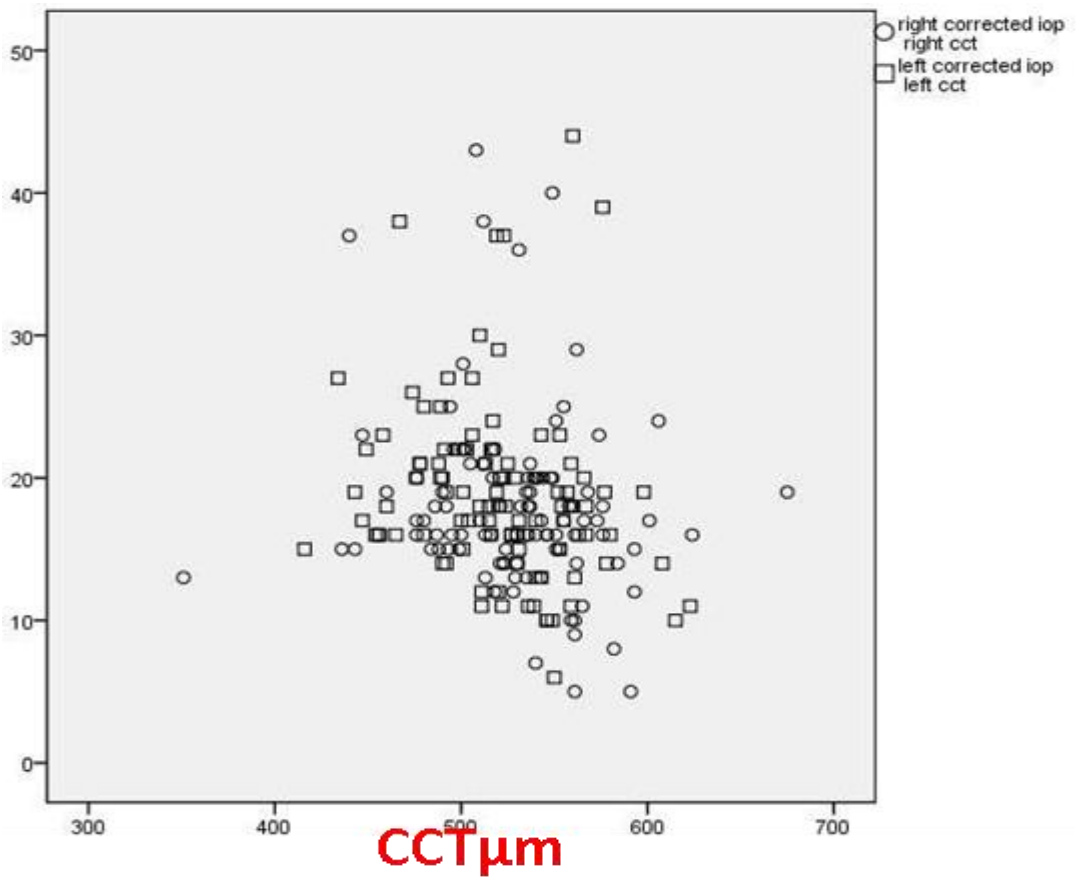

Figure3 : correlation bet. RCCT and RIOP

No significant association was found between RCIOP,LCIOP and age with very weak negative correlation (r= –0.22,p= 0.88, r= –0.06,p= 0.65 respectively) as shown in the figure:4

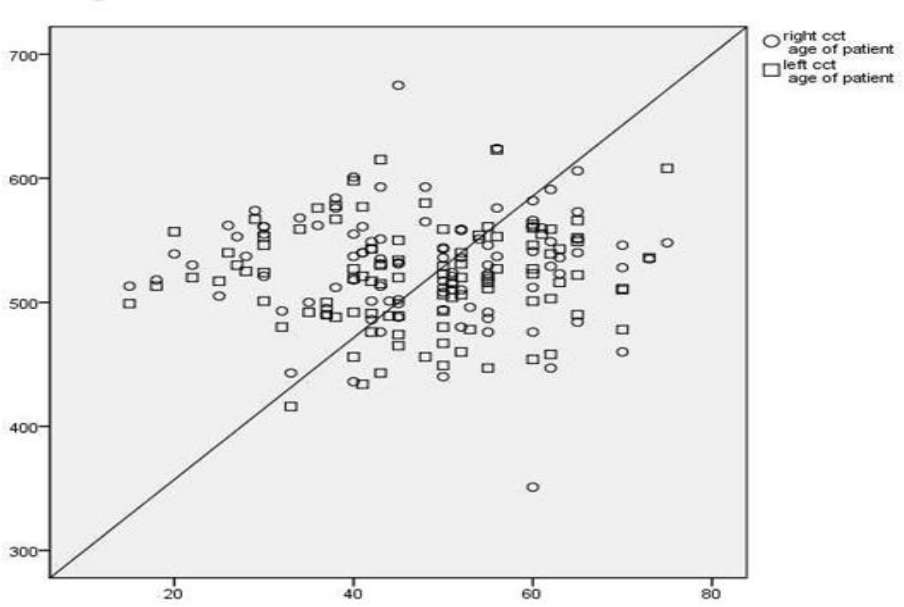

Figure :4 correlation bet. CCT and age

No significant association was found between RCIOP, LCIOP and age (r= –0.12,p= 0.408, r= –0.008,p= 0.96 respectively) as shown in the figure 5:

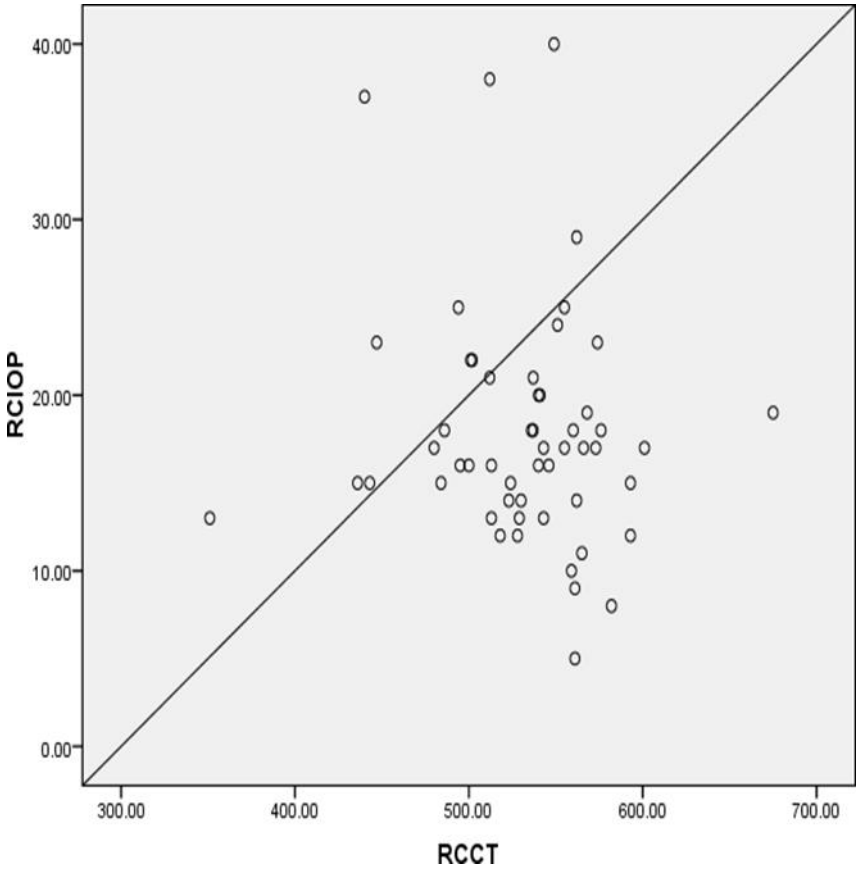

Figure:5 correlation between RCCT and RCIOP males

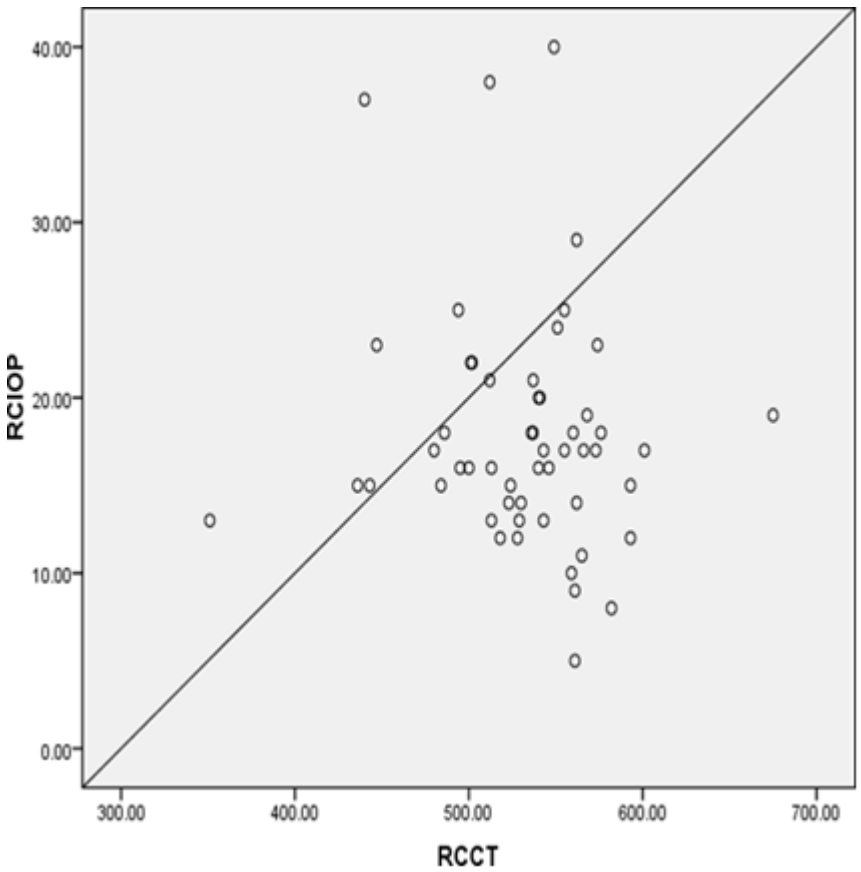

Figure:6 correlation between RCCT and RCIOP females

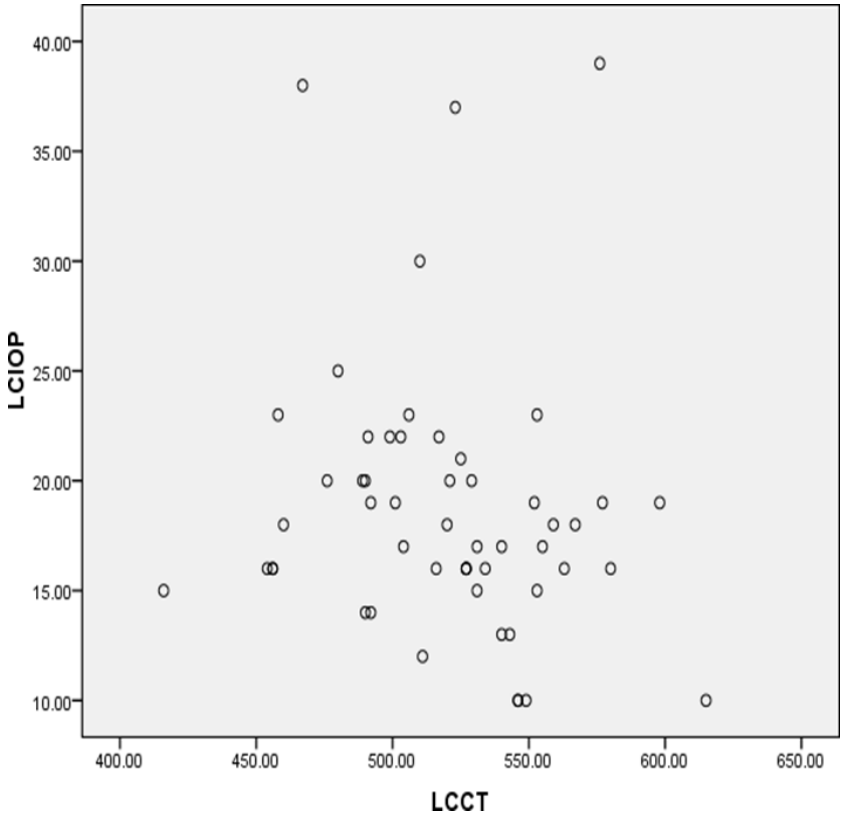

Figure: 7 correlation between LCCT and LCIOP males

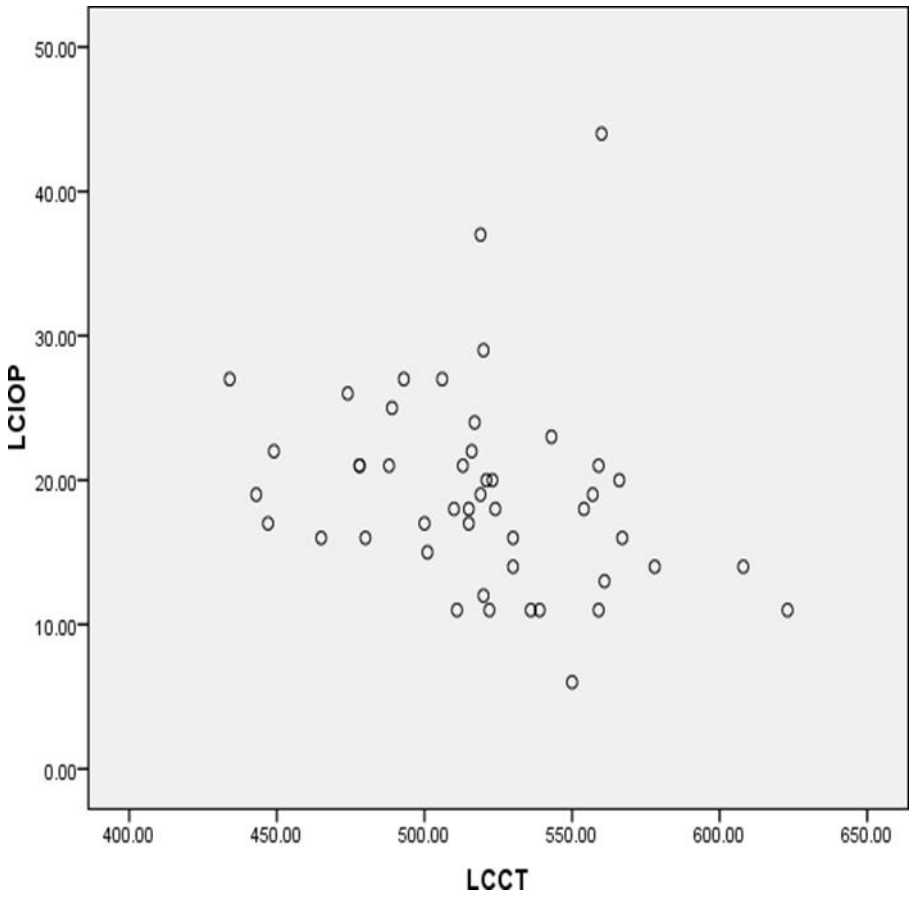

Figure:8 correlation between LCCT and LCIOP females

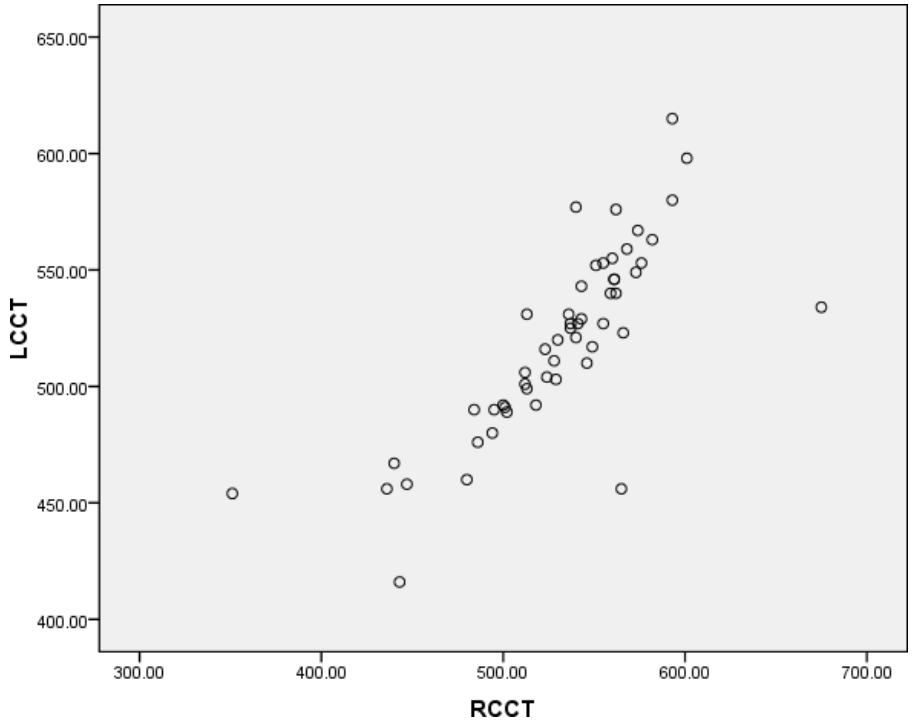

Figure:9 correlation between RCCT,LCCT and age males

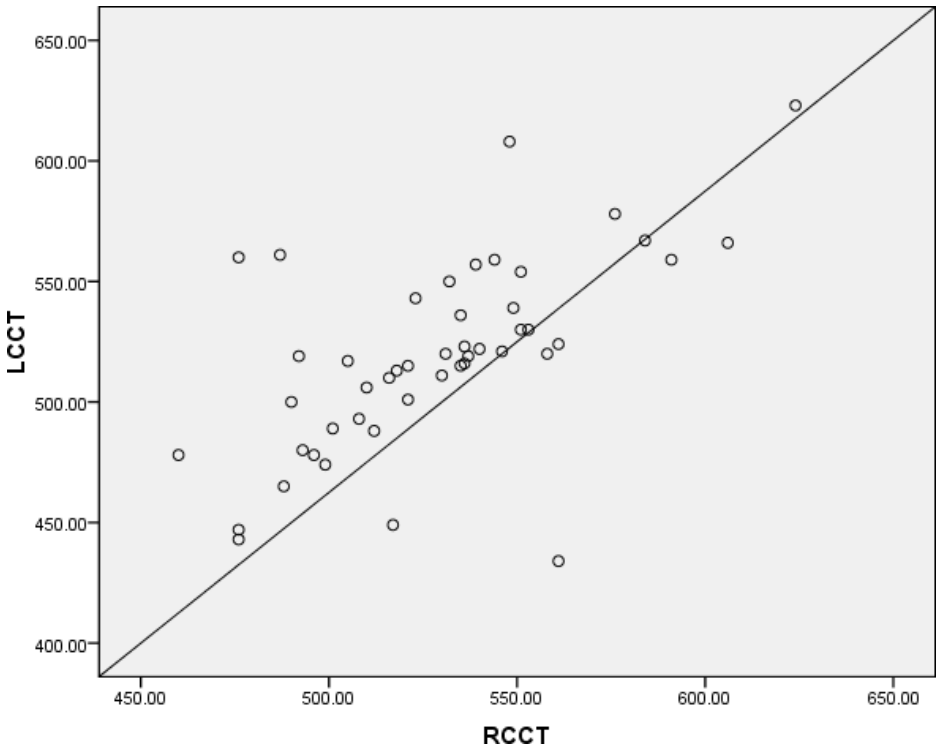

Figure:10 correlation between RCCT,LCCT and age females

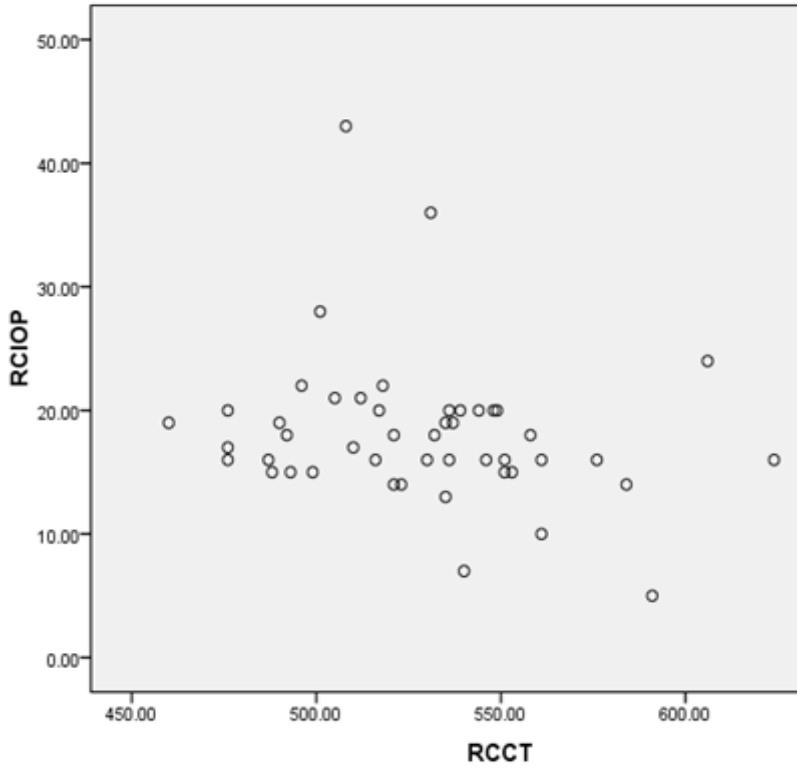

Figure :11 correlation between RCIOP,LCIOP and age males

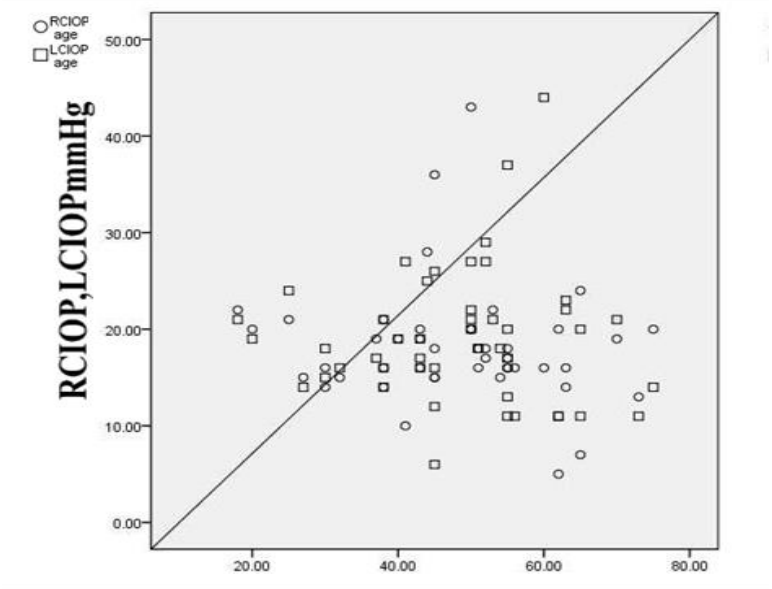

Figure : 12 correlation between RCIOP,LCIOP and age females

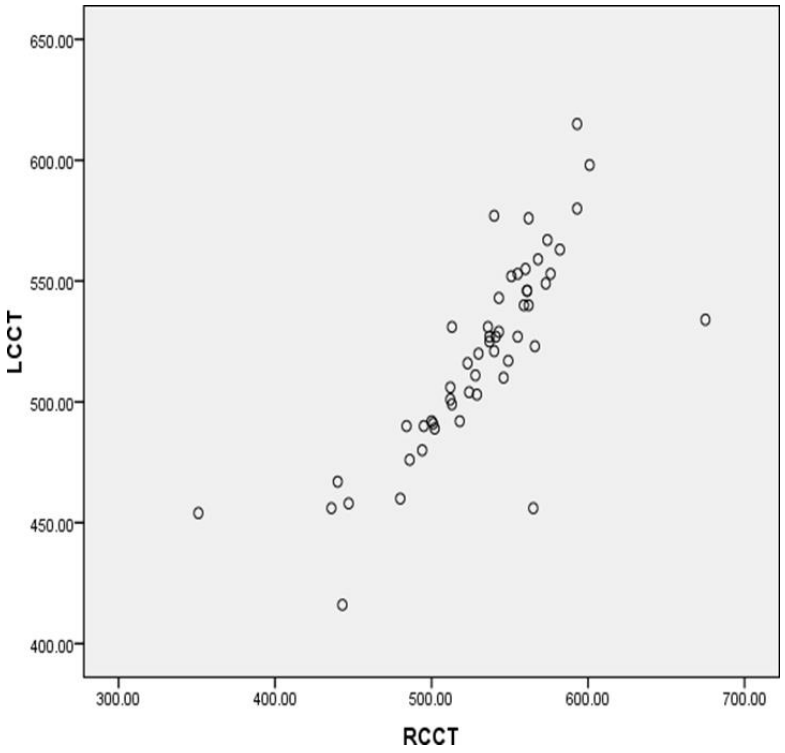

Figure :13 correlation bet. RCCT and LCCT males

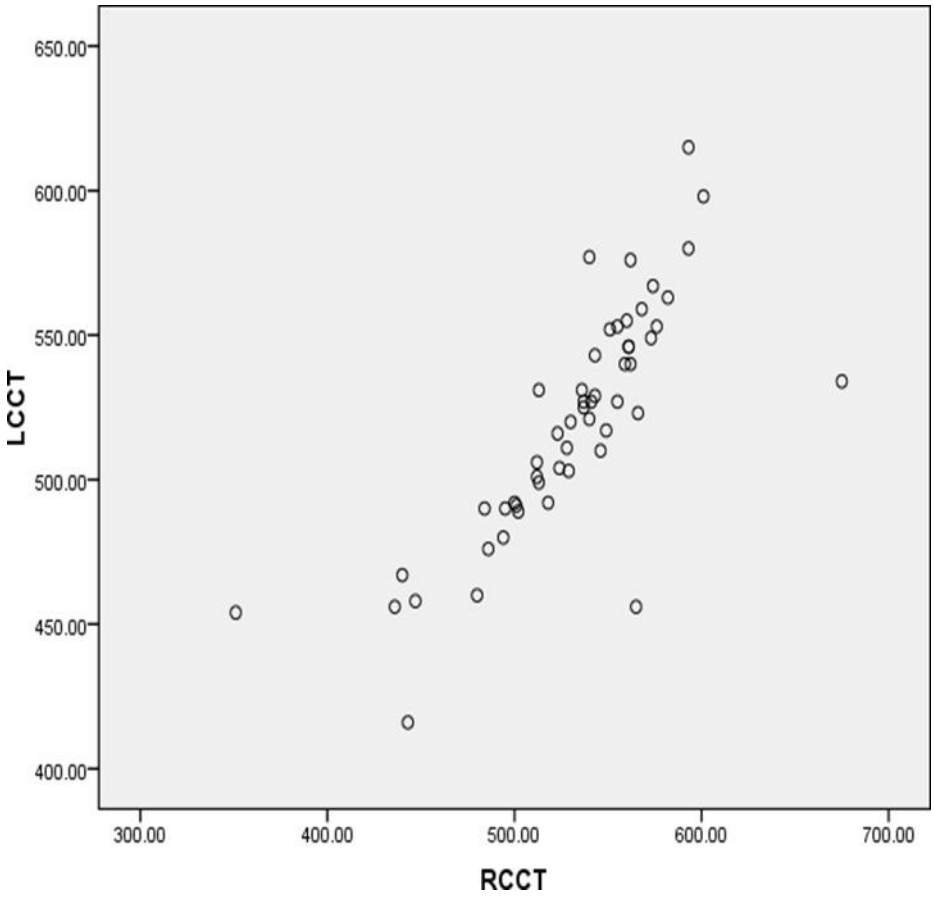

Figure: 14 correlation between RCCT and LCCT females

Discussion

Intraocular pressure measurement by Goldmann applanation tonometry varies with the thickness of the central cornea, the thicker the cornea the higher the measured IOP. (4,32,33) The central corneal thickness is measured with an instrument called the pachymeter. Goldmann tonometry is known to give reliable results on “normal corneae” (i.e., corneal thickness not too different from 520µm.(31) Hoffmann et al (36) reported a normal range 520-550µm by pachymetry. The inter-patient variation in CCT could be a source of error with Goldmann tonometry, where thick cornea cause over estimation of IOP.

Patients with normal tension glaucoma have a higher incidence of thinner cornea (37).

Our study has shown that there is no liner relationship between IOP and CCT and the relation is inverse and not significant In this study it was shown that the difference in mean CCT between males (525.5283µm with st.dev.45.39594) and females (523.92536 µm with std. dev.37.56521µm) was not significant ($p>0.05$).

Similarly, the difference in mean IOP between males (18.3113mmhg with std. deviation 6.48503 mmHg) and females mean18.5851 mmHg with st. deviation 6.47123 (mmHg) was

not significant ($p>0.05$).

Summarily, neither CCT nor IOP were affected by gender. This was consistent with the finding of Lleo et al (38) who reported no significant difference in mean IOP between males (15.47 ± 2.21 mmHg) and females (15.37 ± 2.23 mmHg). No linearity can be predicted between IOP and CCT.

Lleo et al found a correlation between CCT and IOP ($r=0.184$, $p<0.001$ There was a slight association between CCT and age ($r=0.22$, $p<0.05$), although the linear regression was not statistically significant This was in line with the study of Lleo and colleagues who reported a non-linear correlation between CCT and age ($r=0.083$, $p=0.065$). Nemesure et al (34) reported an inverse relationship between CCT and age.

The effect of age suggests age-related corneal biomechanical changes. Our study has shown that there was very weak negative correlation with no statistical significance between CCT μm and age ($r= – 0.023$, $p= 0.13$).

There was strong positive correlation between RCCT and LCCT($r= 0.8$, $p<0.01$) for male and There was moderate positive correlation between RCCT and LCCT($r= 0.6$, $p<0.01$) for female, so increase thickness in right Eye associated with increase thickness in left eye

This study has shown that there is The non-linear association between CCT and IOP and there was no difference between right and left eye.

The slight association between CCT and age indicated a reduction of CCT with increasing age. It was also shown that neither CCT nor IOP was influenced by gender.

the measured IOP should be considered critically on the basis of the CCT Implementation of routine central corneal thickness measurement could change patient management in the general ophthalmologist's practice.

We feel that a pachymeter is an essential item of the ophthalmic equipment armamentarium

CCT is one factor that is necessary to adjust IOP to achieve a more accurate IOP and it allows monitoring for the risk of progression to be more precise. Any decision in glaucoma, in the absence of CCT is an uninformed one.

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