Comparative Analysis of Central Corneal Thickness using Ultrasound and Anterior Segment OCT Pachymetry in Adults attending a Private Eye Clinic in Abuja

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Background: Central Corneal Thickness (CCT) measurement is useful in the management of glaucoma, ocular hypertension, corneal lesions and kerato-refractive surgeries. The Ultrasound Sonography (USS) being a contact test occasionally makes patients anxious and has some limitations. These include the risk of infection and abrasion to the cornea, the discomfort of the numbness due to anaesthetic drops and identifying the exact position to be measured by multiple users is a major challenge. The anterior segment optical coherence tomography (OCT) overcomes these limitations.

Aim: To compare the CCT measurements using USS and OCT, with a view to determine their correlation and the repeatability of each instrument.

Methods: A cross sectional comparative consecutive study carried out on 100 eyes of 50 patients attending Rachel Eye Center in Abuja from January to March 2021. CCT was first measured using the Pachscan ultrasound and then using the Optovue OCT machine, at 10 minutes interval to both eyes. Measurements were taken between nine and eleven am, in a sitting position and by one examiner and using same instrument. The average of two successive readings was taken for all instruments. Data was analysed using SPSS version 20 using Paired Sample t Test, Pearson's correlation, Interclass Correlation and Bland Altman Methods.

Results: Patients were aged between 18 and 79 (mean age of 39.1), 72 males and 28 females. There was a statistically significant difference between both measures. The mean CCT was 537.36 ±33.26 and 510.94 ±33.13 for USS and OCT respectively with a mean difference of (26.42±9.53 p<0.001) [Table 1]. The repeatability of the two instruments using the means of the two repeated test show that the OCT has a smaller mean difference hence a better repeatability than the USS (Table 2). There was a very strong correlation of the 2 sets of measurements (r = 0.959 p<0.001). The correlation of the OCT values was higher than the USS values (Table 3).

Table 1: Descriptive statistics between OCT and USS Pachymeter measurements in 100 eyes

	OCT	USS
Mean + SD	510.940+33.13	537.3600+33.26
Mean difference between USS and OCT (paired sample T test)	26.42+9.53 p<0.001	
Median	510.0000	534.0000
Mode	525.00	517.00
Minimum	439.00	467.00

Table 2: The means of the two repeated test

	Mean	Mean Difference of both readings
USS1	537.4600+33.42382	0.20000+2.55423 (p=0.711)
USS2	537.2600+33.44371	
OCT1	510.9800+33.0123	0.08000+2.55423 (p=0.826)
OCT2	510.9000+33.58526	

Table 3: Pearson correlation

	Pearson Correlation	P value
OCT and USS	0.959	<0.0001
USS1 and USS2	0.994	<0.0001
OCT1 and OCT2	0.997	<0.0001

There was a high average mean intraclass correlation coefficient of 0.843 between the two instruments and this was excellent (0.961) within the 95-percentile upper limit but poor in the (0.096) lower limit (Table 4).

The Intraclass Correlation Coefficient of the OCT was higher than the USS. Howbeit both had excellent ICC values and remained excellent in the upper and lower bound intervals.

Limits of agreement (LOA) was 7.726μm to 45.114μm. Four mean difference values were situated outside the LOA: 4, 51, 66 and 69μm (Figure 1).

Table 4: Intraclass correlation coeffient (ICC)

	Intraclass correlation	95% confidence Interval lower bound	95% confidence Internal Upper bound	P value
ICC (USS/OCT)				
Single Measures	0.728	-0.046	0.926	<0.001
Average Measures	0.843	-0.096	0.961	<0.001
ICC (USS1/USS2)				
Single Measures	0.994	0.989	0.996	<0.001
Average Measures	0.997	0.994	0.998	<0.001
ICC (OCT1/OCT2)				
Single Measures	0.997	0.995	0.998	<0.001
Average Measures	0.999	0.997	0.999	<0.001

If the average interclass correlation is greater than 0.7 it is then acceptable. If greater than 0.9 it is then excellent.
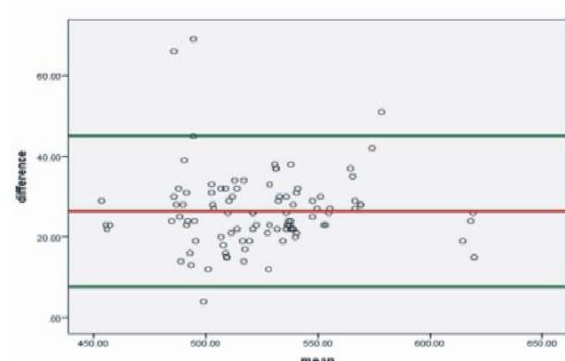

Figure 1: Bland-Altman plot with 95% limits of agreement (LOA)

Discussion: The study showed that the mean CCT using the OCT was significantly lower than the USS. Hence caution has to be taken as these two methods cannot be used interchangeably. In clinical practice we have to take into consideration the lower values OCT measurements produce, as these lower OCT values would cause further falsely elevated corrected pressure values. Hence a different algorithm may need to be used in correcting intraocular pressure as compared to the USS.

Majority of studies done have shown a statistically significant difference, with OCT recording lower measures. [1-7] A few studies reported OCT gives lower values but these values were not statistically different. [8,9] Although Ayala *et al*[10] reported a reverse trend of OCT values being higher than CCT values, this was not statistically significant. Similar to our findings, various studies have also reported a high level of correlation.[1,3,8]

Conclusion: Measurements of CCT using the Pachscan ultrasound and the Optovue OCT correlated well, but the mean Pachscan measures were significantly higher than Optovue measures. This suggests that the two methods are not interchangeable and perhaps a different IOP correction algorithm may need to be developed for the OCT method.

Keywords: *Central Corneal Thickness; Ultrasound Pachymetry; Optical Coherent Tomography*

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