Original Research Paper

Volume - 12 | Issue - 02 | February - 2022 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Ophthalmology

COMPARISON OF COMPUTERIZED PLANIMETRY WITH VISUAL ESTIMATION OF OPTIC DISC

Dr Sheela Manickavel*	Department of Ophthalmology, Sri Ramachandra Institute of Higher Education and Research, Chennai*Corresponding Author
Dr John Davis Akkara	Department of Ophthalmology, Sri Ramachandra Institute of Higher Education and Research, Chennai
Dr M S Joshmitha	Department of Ophthalmology, Sri Ramachandra Institute of Higher Education and Research, Chennai
Prof. Dr Suhas Prabhakar	Department of Ophthalmology, Sri Ramachandra Institute of Higher Education and Research, Chennai

ABSTRACT **Purpose** To compare the reliability in measurements of the Optic disc size and vertical cup-to-disc ratio through visual estimation versus computerized planimetry and to determine if the objective methods stand in for subjective estimation. **Methods** A prospective observational study on one thirty eyes, who underwent a detailed ophthalmic examination, and stereoscopic fundus photographs. The Intra-class observer and Inter-observer reliability was estimated by using intra-class correlation coefficient (ICC) and the Fleiss-kappa. Visual estimation of the optic disc size and vertical cup-to-disc ratio was made by 5 observers (ophthalmologists) and then a planimetric measurement was done by ImageJ software by the investigator in an objective manner. These were then compared statistically. **Results** The clinical subjective visual estimation of the vertical cup disc ratio of 130 fundus photographs by using intraclass correlation coefficient showed a reliability of 0.912 and that of computerised planimetry showed a reliability of 0.932. Interobserver reliability using Fleiss kappa shows substantial agreement in computerized planimetry and fair agreement with visual estimation. **Conclusion** Both visual estimation and computerised planimetry of the optic disc size and vertical optic cup-to- disc ratio were equally reliable. The subjective assessment owes to a large inter and intra observer variabilities, hence a much reliable method is to quantify it using the objective tool. In near future this modality of measuring Optic nerve head parameters would come into light and help the upcoming generation in quick and reliable assessment particularly in the field of glaucoma.

KEYWORDS :

INTRODUCTION:

The optic disc size and cup-to-disc ratio estimation is very important in the diagnosis of glaucoma. Subjective methods of estimation of the optic disc size and cup-to-disc ratio (CDR) are the most widely used clinical tools in documenting the optic nerve head status in screening, diagnosing and monitoring glaucoma. However, estimation of these parameters using optic nerve head photograph is still limited due to high inter-observer and intra-observer variability and the wide range of variability in normal optic disc structure. Though it seems easy to measure the parameters subjectively, it is always challenging to accurately calculate the ratio and conclude without any observer variabilities. It varies between the observers and is often wrongly estimated by unexperienced ophthalmologists. There is also a wide physiological variation in the optic cup-to-disc ratio when it comes to smaller and larger optic discs, and a possible wrong diagnosis for smaller disc have a small CDR and for larger disc with a larger CDR as glaucoma.

To overcome such difficulties, we used the ImageJ software in calculating the size and cup-to-disc ratio. ImageJ is a Java-based image-processing and analysis program. This program is already available as freeware and is widely used in various studies. It helps in rapid acquisition and storage of fundus images. The observer draws the cup and disc margins on the monitor for the software to compute various cup and disc parameters. This study aims to measure vertical cup-to-disc ratio and disc size by using the computerized planimetry and to compare it with manual visual estimation, especially with regard to intra-observer and inter-observer variability. The level of agreement between the two methods is determined to ensure a reliable method for estimation of the optic disc parameters, and use it as a tool for rapid and accurate measurement.

MATERIALS AND METHODS:

It is a prospective observational study conducted for a period of 4 months from November 2020 to February 2021, at a Tertiary health care centre.

One thirty eyes, of sixty-five patients were recruited for the study. Detailed ophthalmic examination was done and good quality stereoscopic fundus photographs were taken. The equipment used was the Zeiss Visucam 500 (Carl Zeiss Meditec AG, Jena, Germany) with standard field of view from a single desktop fundus camera. The fundus photographs with obscuration of optic disc cup, blurring of disc margins, or any media opacities causing ill defined images were excluded from the study. The stereoscopic fundus photographs were numbered from 1 to 130 by 5 observers (ophthalmologists). The vertical disc and cup margins were drawn on the monitor with the computer mouse. They were asked to visually estimate the vertical cup-to-disc ratio and size of optic disc as small, medium, and large. The assessment made by one observer is masked to the other observers. Each observer marked the margins on the images and estimated the parameters independent of the others readings. Later, the same images were sent for an objective evaluation and measurements were made by the computerized planimetry using ImageJ software. This procedure was repeated for the 5 set of photographs.

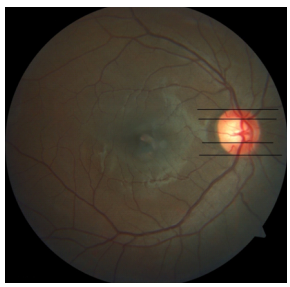


Image 1: Markings made on the stereoscopic fundus photograph

Statistical Analysis:

Data was analysed by using SPSS (Statistical Package for the Social Sciences) statistical package version 21.0. Normality of the data was tested by using the Shapiro-Wilks test and Values are expressed as number and percentages for categorical variables and Median and IQR (Inter quartile range) for continuous variables. Reliability of the Computerized planimetry and Visual estimation of optic disc was assessed by calculating the intra-class correlation (ICC). ICC Value of <0.50 were considered as poor, 0.50-0.74 as moderate, 0.75-0.89 as

good and >0.90 as excellent. Inter-observer reliability was estimated by using Fleiss-kappa, Kappa values <0.20 as poor,0.21 -0.40 as fair, 0.41-0.60 to be moderate, 0.61-0.80 as good, 0.61-0.81 -1.0 as very good, spearman rank correlation was used to assess the criterion validity against the computerized planimetry and visual estimation of optic disc. Correlation value of <0.24, 0.25-0.49, 0.50-0.74, >7.5 were considered as NO, weak, moderate and strong correlation respectively. Pearson's chi-square test was used to assess the association between computerized planimetry and visual estimation of Optic disc size. All the tests were performed at p-value <0.05 considered as significant.

Table 1: Test- retest assessment of the Computerized planimetry and Visual estimation of optic cup-to-disc ratio (N=130)

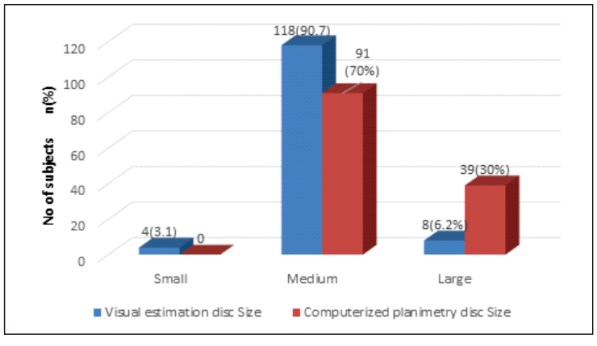
Variable	Observer1 Median (IQR)	Observer2 Median (IQR)	Observer3 Median (IQR)	Observer4 Median (IQR)	Observer5 Median (IQR)	ICC	P-value*
Visual estimation	0.45(0.13)	0.44(0.11)	0.47(0.13)	0.45(0.13)	0.44(0.10)	0.91	0.001
Computerized Planimetry	0.45(0.20)	0.40(0.20)	0.40(0.10)	0.45(0.20)	0.40(0.20)	0.93	0.001

*p-Value<0.05 considered as significant using the intra-class correlation co-efficient

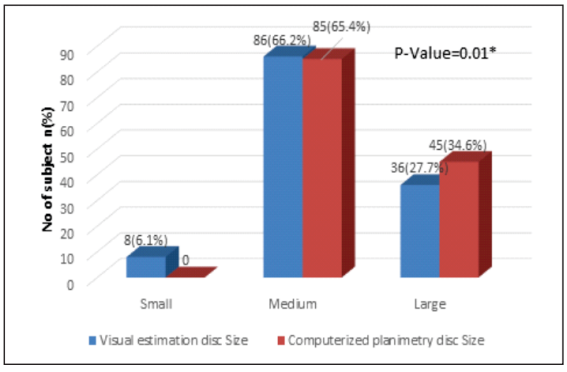
Table 2: Inter-observer reliability of Computerized planimetry and Visual estimation of optic disc size(N=130)

Variable	Observer1	Observer2	Observer3	Observer4	Observer5	Fleiss-Kappa	P-value*
Computerized Planimetry of optic disc size							
Small	-	-	-	-	1(0.7)	0.71	0.001
Medium	91(70.0)	85(65.4)	91(70)	90(69.2)	98(75.4)		0.001
Large	39(30.0)	45(34.6)	39(30)	40(30.8)	31(23.9)		0.001
Visual estimation of optic disc size							
Small	4(3.1)	8(6.2)	2(1.5)	1(0.8)	3(2.3)	0.24	0.001
Medium	118(90.7)	86(66.2)	121(93.1)	98(75.4)	112(86.2)		
Large	8(6.2)	36(27.7)	7(5.4)	31(23.8)	15(11.5)		

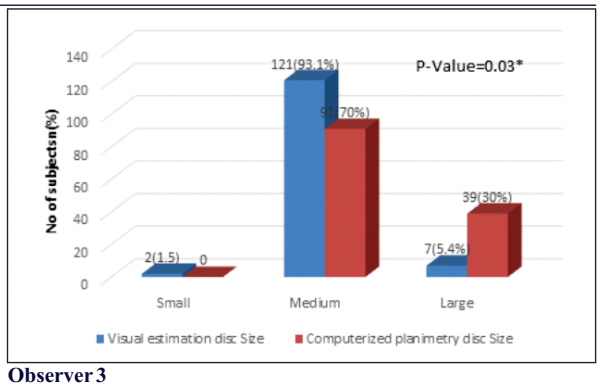
Figure 1: Association between Computerized planimetry and Visual estimation of optic disc size(N=130)



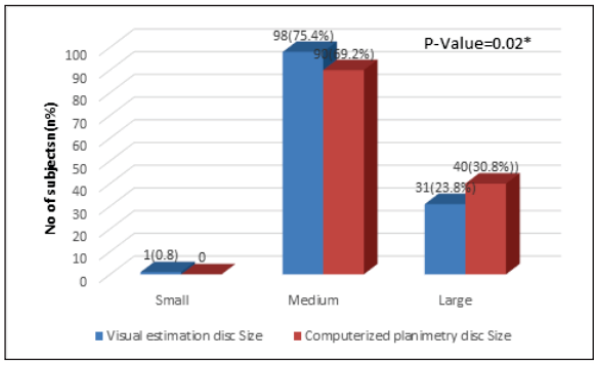
Oberver1



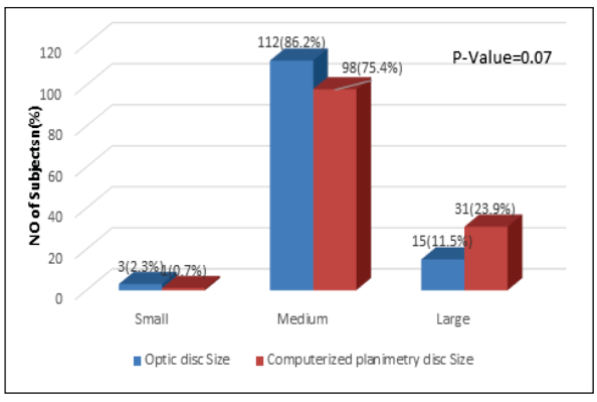
Observer 2



Observer 3



Observer 4



Observer 5

In this study we compared the criterion validity of computerized planimetry with visual estimation of optic disc, cup-to-disc ratio and found there was strong agreement using spearman correlation coefficient. Reliability using intraclass correlation coefficient of computerised planimetry shows 0.932 and visual estimation shows 0.912. Interobserver reliability in measuring the optic disc size using Fleiss kappa shows substantial agreement in computerized planimetry and fair agreement with visual estimation.

DISCUSSION:

Estimation of optic disc, cup-to-disc ratio are important in the management of glaucoma. The optic disc changes usually precede the visual field defects.[5] Hence, a standard method of measuring optic disc cupping is important in assessing its early damage.

Sung et al observered the intra-observer and inter-observe variability between a digital stereo optic disc camera (Discam) and Heidelberg retina tomograph (HRT) in measuring area cup-disc ratio (ACDR) and radial cup-disc ratio (RCDR) done by 2 observers. The variation in ACDR and RCDR measurements between the two observations was too high to use on regular basis.[6] The ICCs were 0.97 and 0.92 respectively. The interobserver agreement in HRT was almost to the point (ICC = 0.97), whereas the Discam interobserver agreement was substantial (ICC = 0.79). In our study, we used the Image J software in measuring optic cup-to-disc ratio and found a strong interobserver agreement of 0.932.

Arthur et al studied agreement between planimetric methods and HRT which showed substantial agreement which can be compared with our study showing strong agreement between two methods.7 Hatch et al had found the agreement between the planimetric method and HRT in measuring areas of cup-disc ratios which was had moderate to substantial in three observers (ICC = 0.57 to 0.65).8 The overall agreement between the methods was good, but the mean estimates were statistically different.

For planimetric methods disc size ranging from <1.6mm 2-small, 1.6-2.6mm, 2-moderate, >2.6mm, 2-large) used as cut offs for classification. Papastathopoulos et al explained the horizontal and vertical dimensions of the eyeball were correlated with the optic disc size.[9] Kim et al evaluated the ImageJ software in analyzing the colour of the optic disc. They examined and found that the grey scale of the brightest cupping center was diminished with age in the group with suspected glaucoma.[10] In our study, using the same software we found a substantial agreement in calculating optic disc size which was comparable to the fair agreement by visual estimation. This was similar to a study done by Rao et al where they correlated the disc diameter assessed by biomicroscopy as small, average and large discs to the categorization by Heidelberg retina tomography (HRT). They found a moderate agreement in the stereo biomicroscopic measurements.[11]

The main limitation of this study is that individual ophthalmologists were asked to mark the margins. They also calculated the values of cup-to-disc ratio and disc size using image J software as well as visually. It may give better results if one standard cut off values may be used so that evaluation done by ophthalmologists can be compared easily.

CONCLUSION:

Both visual estimation and computerised planimetry of the optic disc size and vertical optic cup-to- disc ratio were equally reliable. The subjective assessment owes to a large inter and intra observer variabilities, hence a much reliable method is to quantify it using the objective tool. In near future this modality of measuring Optic nerve head parameters would come into light and help the upcoming generation in quick and reliable assessment particularly in the field of glaucoma.

REFERENCES

1. Snyder BM, Nam SM, Khunsongkiet P, Ausayakhun S, Leeungurasatien T, Leiter MR, et al. Accuracy of computer-assisted vertical cup-to-disk ratio grading for glaucoma screening. PLOS ONE. 2019 Aug 8;14(8):e0220362.
2. Zangwill L, Shakiba S, Caprioli J, Weinreb RN. Agreement between clinicians and a confocal scanning laser ophthalmoscope in estimating cup/disk ratios. Am J Ophthalmol. 1995 Apr;119(4):415–21.
3. Tielsch JM, Katz J, Quigley HA, Miller NR, Sommer A. Intraobserver and interobserver agreement in measurement of optic disc characteristics. Ophthalmology. 1988 Mar;95(3):350–6.
4. Bearer EL. Overview of Image Analysis, Image Importing, and Image Processing Using Freeware. Curr Protoc Mol Biol. 2003 Aug;CHAPTER:Unit-14.15.
5. Klein BE, Moss SE, Magli YL, Klein R, Johnson JC, Roth H. Optic disc cupping as clinically estimated from photographs. Ophthalmology. 1987 Nov;94(11):1481–3.
6. Sung VCT, Bhan A, Vernon SA. Agreement in assessing optic discs with a digital stereoscopic optic disc camera (Discam) and Heidelberg retina tomograph. Br J Ophthalmol. 2002 Feb 1;86(2):196–202.
7. Arthur SN, Aldridge AJ, De León-Ortega J, McGwin G, Xie A, Girkin CA. Agreement in Assessing Cup-to-Disc Ratio Measurement Among Stereoscopic Optic Nerve Head Photographs, HRT II, and Stratus OCT. J Glaucoma. 2006 Jun;15(3):183–9.
8. Hatch WV, Trope GE, Buys YM, Macken P, Etchells EE, Flanagan JG. Agreement in assessing glaucomatous discs in a clinical teaching setting with stereoscopic disc photographs, planimetry, and laser scanning tomography. J Glaucoma. 1999 Apr;8(2):99–104.
9. Papastathopoulos KI, Jonas JB, Panda-Jonas S. Large optic discs in large eyes, small optic discs in small eyes. Exp Eye Res. 1995 Apr 1;60(4):459–61.
10. Kim US, Kim SJ, Baek S-H, Kim H-K, Sohn Y-H. Quantitative Analysis of Optic Disc Color. Korean J Ophthalmol KJO. 2011 Jun;25(3):174–7.
11. Rao HBL, Sekhar GC, Babu GJ, Parikh RS. Clinical measurement and categorization of optic disc in glaucoma patients. Indian J Ophthalmol. 2009;57(5):361–4.