



TO STUDY THE CORRELATION BETWEEN SCHIOTZ AND APPLANATION TONOMETRY IN GLAUCOMA SUSPECTS AND DISEASED - A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT **PURPOSES:** To correlate the intraocular pressure readings obtained by Schiötz Tonometer and Goldmann Applanation Tonometer (GAT). To find the degree of agreement between both tonometers.

METHODS: 300 eyes of 150 glaucoma suspects and diseased subjects were selected from various age groups. Their IOP was assessed using Schiötz tonometer and GAT and the readings were compared.

RESULTS: Average age of the patients was 55 years. There was a positive linear correlation between Schiötz and GAT established for both eyes, which was statistically significant. RE showed better agreement as per agreement graph.

CONCLUSION: Schiötz tonometer showed significant correlation with the Gold standard technique (GAT) over a wide range of age groups. Hence, Schiötz tonometer is a reliable screening tool that can be used in community outreach ophthalmology services in a developing country like India.

KEYWORDS : Intra ocular pressure, Schiötz tonometer, GAT.

INTRODUCTION

Glaucoma is the leading cause of irreversible blindness worldwide and is also the second leading cause of overall blindness as such.¹ In India glaucoma is the third leading cause of blindness with 12 million people affected accounting for 12.8% of the country's blindness. Population based studies report a prevalence between 2 to 13 %.²

The high rate of blindness in the Indian population is due to high proportion of undiagnosed glaucoma in the community. Glaucoma was undetected in more than 90% of individuals identified in the population studies. Inadequate identification of glaucoma even in population undergoing ophthalmic evaluation continues to be a major determinant of preventable blindness due to glaucoma in India.³

Once the blindness of glaucoma has occurred, there is no treatment that will restore vision. In nearly all cases, however, blindness is due to glaucoma is preventable. This prevention requires early detection and proper treatment.⁴

The important crux of any glaucoma program must be "case detection". When patients come to us for any ocular problem we should use the chance to detect glaucoma in those cases. The idea is to properly diagnose and treat those clearly defined glaucoma cases those which have failed to be properly diagnosed for various reasons.⁵

Good case detection depends on using tests with high positive predictive values such as perimetry, tonometry and fundus examination to all the patients who visit our clinic for various eye ailments.⁶

IOP measurement remains the mainstay in diagnosis of glaucoma and also measuring compliance of glaucoma treatment. The Intraocular pressure (IOP) is measured with the help of an instrument called as tonometer. The intraocular pressure within the eye normally varies from 10-20 mm Hg, most accurately measured by manometry.⁷ The normal level of IOP is essentially maintained by a dynamic equilibrium between the formation and outflow of Aqueous humor.⁸

IOP is the primary focus in the diagnosis and treatment of glaucoma for many years.⁹ However, for early diagnosis of glaucomatous damage new technologies such as new tonometers, new OCT machines and optic nerve head analysers etc. are of paramount importance.¹⁰

MATERIAL AND METHODS

This prospective observational hospital based study was conducted

between January 2019 to June 2020 on 150 glaucoma suspect and diseased patients attending the ophthalmology OPD of Department of Ophthalmology, G.R. Medical College and J.A. Group of Hospitals, from January 2019 to June 2020.

The associated relevant examinations including visual acuity, pupillary reaction, flashlight test, Van Herick test, Slit lamp biomicroscopy, funduscopy, Schiötz Tonometry, applanation tonometry and gonioscopy were carried out.

Study included both male and female patients & glaucoma suspect and diseased patients. Patients with any corneal pathology that can interfere with the Applanation tonometry (e.g. Corneal scarring, corneal abrasion, keratitis, keratoconus, ocular herpes, trauma), history of previous corneal surgery including refractive surgery, microphthalmos, high astigmatism, blepharospasm, nystagmus excluded.

METHOD OF COLLECTION OF DATA:

Detailed slit lamp evaluation was done for every case under Zeiss slit lamp and the findings were recorded.

Intraocular pressure were measured in all cases first with Schiötz tonometer then with Goldmann Applanation Tonometer. These readings were taken for each eye with each tonometry method.

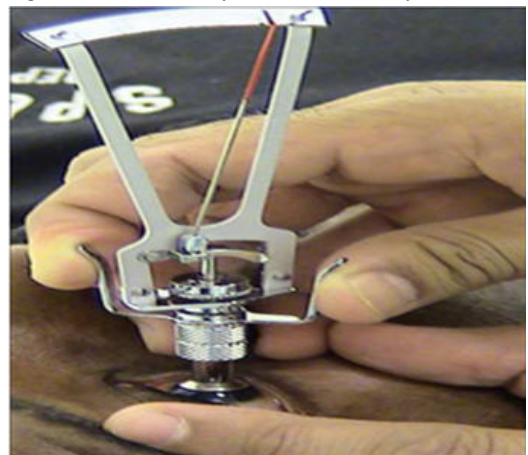


Fig. 1 : Iop Measurement By Schiötz Tonometer

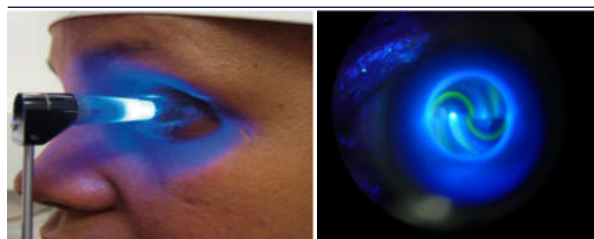


Fig. 2 : Iop Measurement By Goldmannapplanation Tonometer

RESULTS

In this study a total of 150 patients were subjected to two methods of tonometry – Schiottz and Goldmann Applanation tonometry.

1. Mean Iop According To Clinical Diagnosis

Table 1(a) : St

Number of cases		Mean IOP		SD		Minimum IOP		Maximum IOP		P		
		(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	
ST	Diseased	76	21.54	21.18	7.35	7.44	12.00	12.00	37.00	37.00	0.010	0.045
	Suspect	74	18.89	19.14	4.71	4.71	17.00	17.00	37.00	37.00		
Total		150										

In the schiottz tonometer, mean IOP for right eye in diseased patients was 21.54±7.35 while for suspects it was 18.89±4.91 And mean IOP for left eye in diseased patients was 21.18±7.44 while for suspects it was 19.14±4.71. The difference is statistically significant in both the eyes.

Table 1(b): Gat

Number of cases		Mean IOP		SD		Minimum IOP		Maximum IOP		P		
		(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	(RE)	(LE)	
GAT	Diseased	76	20.89	19.93	9.86	8.23	10.00	10.00	54.00	54.00	0.003	0.011
	Suspect	74	16.97	16.97	5.69	5.52	10.00	10.00	40.00	42.00		
Total		150										

In the GAT, mean IOP for right eye in diseased patients was 20.89±9.86 while for suspects it was 16.97±5.69 And mean IOP for left eye in diseased patients was 19.93±8.23 while for suspects it was 16.97±5.52. The difference is statistically significant in both the eyes.

Table 2 : Clinical Agreement Between Schiottz And Applanation Tonometer

Range	No. of eyes	% of eyes
±1	49	16.3
±3	136	45.3
±5	206	68.7

In our study Out of 300 eyes in terms of percentages only 16% of applanation readings falling within the Schiottz range of IOP readings obtained with the 5.5g weight, About 45% of the applanation readings falling within the Schiottz range ± 3 mmHg and 69% within Schiottz range ± 5 mmHg.

Table 3 : Correlation Between Schiottz And Applanation Tonometers

	Correlation coefficient	p value
ST(RE) Vs GAT(RE)	0.762**	0.000**
ST(LE) Vs GAT(LE)	0.785**	0.000**

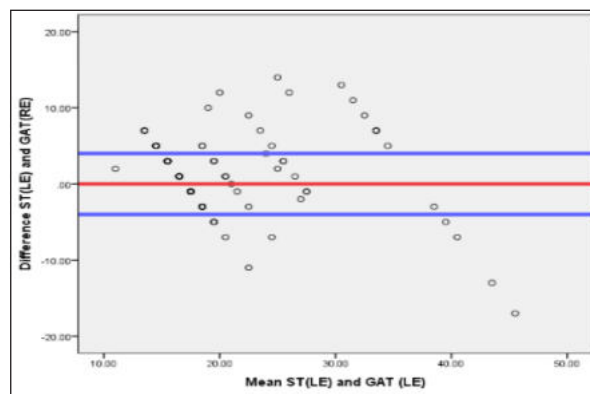
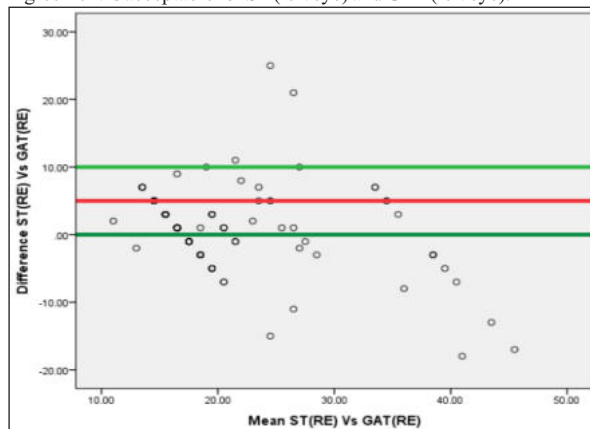
In both the eyes highly positive significant correlation (p<0.05) found between both the tonometers.

Table 4 :agreement Plot Between Schiottz And Applanation Tonometers

Difference	Mean	Standard Deviation	μ+1.96*σ	μ-1.96*σ
ST(RE) Vs GAT(RE)	1.27	5.37	11.79	-9.25
ST(LE) Vs GAT(LE)	1.70	4.49	10.50	-7.10

Seeing the **Bland-Altman plot for agreement** for right eye, it is seen

that good agreement exist between ST (right eye) and GAT (right eye). Agreement is acceptable for ST (left eye) and GAT (left eye).



Graph 1 : Bland-altman Plot For Agreement

DISCUSSION

There are many parameters for glaucoma screening namely IOP assessment, slit lamp and optic nerve head evaluation. However, IOP measurement is the most important parameter not only for diagnosis but also for follow up of glaucoma cases.

A number of instruments and techniques are being followed to measure IOP. Newer technologies give the IOP measurement with least error. But these instruments cannot be used for screening purpose. Moreover, they can be allowed to replace the existing or to be considered as equal with the current gold standard only after it has been tested in different clinical settings and in different population groups. Conversely, the current gold standard instrument i.e. applanation tonometer has to be constantly evaluated against the new technology, so that its errors and biases can be eliminated. Evaluation of techniques used for measurement of IOP can help in finding out a quick, accurate and patient friendly method for IOP assessment which can be used for the purpose of screening. It may be crucial in increasing the diagnostic rate of glaucoma among the patients attending ophthalmology clinics.

The present study has been conducted with the objective of finding out if age old Schiottz tonometer can be used for the purpose of screening after duly comparing it with the gold standard applanation tonometer.

The reasons for use of Schiottz tonometer are many viz easy, economical & quick technique and its portability. It is used in many parts of the world even today including our outpatient department for the above mentioned reasons.

Goldmann applanation tonometer (GAT) “The gold standard technique” although a bit time consuming, cumbersome and not so patient friendly technique for IOP assessment, was being used for comparison with Schiottz tonometry. The GAT has stood the test of time in giving accurate and reliable IOP values in various groups of patients in different demographic profiles.

In our study a total of 300 eyes of 150 patients were evaluated with two tonometers namely schiottz and GAT.

Demographic profile of our study showed that males (54.7%) were more than the females (45.3%). The minimum and maximum age of patients among those participated in this study was 21 & 83 years respectively.

With respect to **clinical diagnosis based difference in IOP** prevalence, there was Higher IOP was noted in both eyes in both the tonometers in Diseased group of patients than suspects as it defines itself by the diagnosis of Glaucoma which is usually characterized by raised IOP.

The Schiottz tonometer had a specific practical problem – movement of the patient and the pulsation of the pointer about 0.5-1mm while recording the scale reading made it impossible to get very accurate readings.^{11,12}

Even a 0.5 mm error while reading the position of the pointer on the scale, would result in an erroneous value being taken as the true intraocular pressure.

Clinically schiottz indentation tonometer is not having much agreement with applanation tonometer as in our study in terms of percentages as only 16% of applanation readings fell within the Schiottz range of IOP readings obtained with the 5.5g weight, About 45% of the applanation readings fell within the Schiottz range ± 3 mmHg and 69% within Schiottz range ± 5 mmHg.

Similar to study as demonstrated by **Jackson et al** To put down the reliability of the Schiottz tonometer in terms of percentages, only 40% of applanation readings fell within the Schiottz range of IOP readings obtained with the 5.5g weight, About 80% of the applanation readings fell within the Schiottz range ± 3 mmHg and 95% within Schiottz range ± 5 mmHg. He observed that the variability of the readings between applanation and Schiottz was more with higher loads of weight. He thus concluded that the Schiottz tonometer provided only a range of pressures within which the IOP of the eye measured lay, rather than a precise single IOP level.¹²

C Jackson et al study is the perfect agreement of our study which states that the Schiottz tonometer was the most generally reliable instrument with 64% to 76% of values within 4 mm of the Goldmann.¹³

In order to assess the consistency of different tonometers in giving reliable results, **intra class coefficient study** was done for both the eyes. Intra class coefficient study is the assessment of consistency or reproducibility of (IOP) measurements made by different instruments measuring the same quantity.

Next the intra class coefficient study showed that there was very strong correlation between schiottz and GAT. This was given by the correlation values of >0.76 in both eyes, which suggest a very strong statistically significant correlation. The similar results were confirmed in a study by **Prasanthi M et al**¹⁴ which states that there is good statistically correlation between the schiottz tonometer and GAT methods of IOP measurement.

S. Nagarajan et al.¹⁵ study also suggests that both the tonometers showed a statistically significant correlation with the gold standard technique over a range of IOP & CCT with the schiottz tonometer better than NCT.

Chiara GF et al also suggests Good correlations, ranging from +.85 to +.68, were achieved between the applanation and indentation modes.¹⁶

In order to find the 'agreement' of a new investigation with the gold standard technique a **Bland–Altman plot analysis** is made. This is a type of data plotting used for analysing the agreement between two different investigations under study.

This showed that there was good agreement between schiottz and GAT. Similar to the study by **S. Nagarajan et al**¹⁶ which states that schiottz indentation tonometer was found to agree better with Perkins than NCT suggesting that the IOP measurements by the schiottz indentation tonometer are still clinically acceptable.

But when it comes to manage glaucoma even 1 mmHg IOP can matter as it reduces risk of progression by 10%. According to the Early Manifest Glaucoma Trial (EMGT) Lowering IOP decreased the

proportion of subjects who progressed and delayed the progression.¹⁷

However, this study proves that schiottz tonometer can be recommended as a reliable screening tool in community outreach ophthalmology services.

CONCLUSION

Accurate IOP assessment is of pivotal importance in glaucoma management. GAT is the gold standard technique of IOP assessment in glaucoma patients, giving reliable and accurate readings. Schiottz tonometer though economical, portable, light weight, easy and quick method of IOP assessment is clinically less reliable. Hence can be recommended as a screening tool in community outreach ophthalmology services, but not in glaucoma management.

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