**Original Research Article**

# Comparative study between schiotz tonometer and goldmann applanation tonometer in glaucomatous and normal individuals

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## ARTICLE INFO

## ABSTRACT

**Purpose:** Checking of intraocular pressure (IOP) is one of the basic investigations in a general ophthalmology work up. In this study we attempted to compare the IOP readings obtained by Goldmann applanation tonometer and Schiotz indentation tonometer in glaucomatous and normal individuals attending general ophthalmology OPD in a tertiary care centre in Central Rajasthan.

**Materials and Methods:** It is a case series study in which IOP was checked in patients using two tonometers. Statistical analysis was done to evaluate the agreement between instruments.

**Result:** In this study, when measured with Goldmann applanation tonometer (GAT), it was found that the mean IOP of both right and left eye in group A (Glaucomatous subjects) (24.19±12.94 and 23.34±13.73 respectively) was significantly higher than mean IOP of both right and left eye in group B(non glaucomatous subjects) (15.06±2.49 and 15.12±2.38 respectively). Likewise, when measured with Shiotz tonometer (ST), mean IOP of both right and left eye in group A (26.05±11.93 and 24.65±12.28 respectively) were very significantly higher in comparison to group B (16.79±2.64 and 16.85±2.47 respectively).

**Conclusion:** The mean pressures obtained by the Schiotz tonometer were higher than the mean Goldmann pressures which indicate that the Schiotz tonometer tends to read higher than the Goldmann tonometer.

## 1. Introduction

Glaucoma is a chronic multifactorial progressive optic neuropathy with characteristic structural changes in the optic nerve head reflected in the visual field.[1,2] Glaucoma is the leading cause of irreversible blindness with POAG being the prevalent type. Glaucoma is the second most common cause of blindness worldwide. It is estimated that the global burden of glaucoma to be 60 million and it would be 79.6 million by 2020 and 111.8 million by 2040. In India, glaucoma is the leading cause of irreversible blindness with at least 12 million people affected and nearly 1.2 million people blind from the disease.[3,4] More than 90 percent of cases of glaucoma remain undiagnosed in the community. Glaucoma prevalence increases with age. In Asia, population-based studies from China and India have reported that a significant percentage of the population suffer from angle-closure glaucoma.[5]

Burden of high rate of blindness occurs due to the more presence of undiagnosed glaucoma in the community. Chennai glaucoma study as well as Aravind comprehensive eye survey observed that more than 90 percent cases of glaucoma were undiagnosed and were identified only at the time of study. Glaucoma affects one in two hundred people aged fifty years and younger, and one in ten over the age of eighty years. In most cases, it is detected only after loss

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in vision. When the blindness of glaucoma has occurred, no treatment is there till date that could restore back the vision. However, blindness because of glaucoma is preventable, so early detection and prevention is the only way to avoid total loss of vision.

The important aim of any glaucoma program must be "case detection". Proper case selection depends on investigations with high reliable values such as perimetry, tonometry and fundus examination.

For early diagnosis of glaucomatous damage we should go for new technologies such as advanced new tonometers, new OCT machines & optic nerve head analysers etc. which are of more importance.[6]

Presently the diagnosis of glaucoma is done on the basis of structural and functional changes found in retinal nerve fibre layer, however, IOP is the only factor which can be used to titrate the treatment. IOP is also an important factor whose reduction can bring about good prognosis and slow down the disease. So, an accurate assessment of IOP is of paramount importance in glaucoma cases.[7]

While treating the glaucoma patients, lowering of IOP by either surgical or pharmacological means is the important factor in slowing both structural and functional loss of retinal nerve fibers. So, perfect measurement of IOP is of utmost importance in such patients. Clinically IOP cannot be measured directly as such but can be checked indirectly through the state of tension of the tunics of the eyeball. Checking of intraocular pressure is an important procedure in our clinics used for accurate diagnosis of glaucoma cases. As glaucoma types and risk factors vary from population to population, we did this study to shed a light on its pattern in central Rajasthan.

## 2. Materials and Methods

This is a case series study which was conducted in the Department of Ophthalmology, J.L.N. Medical College and Associated Hospitals, Ajmer (Rajasthan) for a period of one and half years after taking written informed consent from the patients and their relatives and was approved by the institutional ethics and research committee. All cooperative patients of both sexes, age above 20 years were included in this study. Patient having age less than 20 years, previous corneal surgeries and preexisting corneal pathology were excluded from this study.

### 2.1. Study methods

IOP measurement by Schiotz and Applanation Tonometer was done under topical anesthesia.

### 2.2. Study design

1. Cases were included by considering the above inclusion and exclusion criterias.
2. Demographic data were noted.

Following parameters were checked before measuring the IOP in study patients

1. Best corrected visual acuity (BCVA)
2. Detailed anterior segment examination with slit lamp
3. IOP measurement using Schiotz and GAT
4. Pupil was dilated to see the fundus for any glaucomatous changes (Under close monitoring of IOP)
5. Field analysis with Humphrey field analyser (30-2)
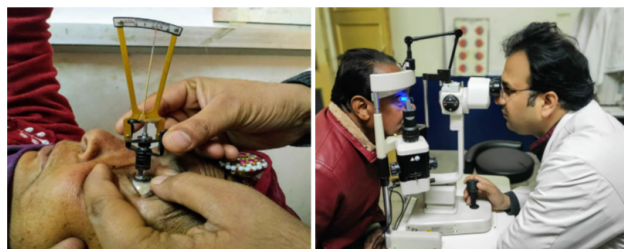6. Gonioscopy done if required or indicated



**Fig. 1:** Schiotz tonometry goldmann applanation tonometry

## 3. Result

Considering the paucity of community glaucoma studies, we conducted this study with the objectives of studying the effects of age, sex, laterality over the checking of IOP and also to compare the intraocular pressure readings obtained by both the tonometers in glaucomatous and normal individuals. For glaucoma screening and diagnosis, there are many parameters but out of many; measuring of IOP is most important.

Researchers are doing a constant search to improvise the methods of intraocular pressure measurements to minimize the errors due to many variable factors. Although newer technologies with least possible error have been discovered for IOP measurement. But these instruments have should be tested in different clinical settings in different population groups before they could be replaced the existing one.

Our study is an effort to compare the IOP readings measured by both tonometers in glaucomatous and normal individuals. A total of 206 patients were enrolled and divided in two groups [Group A: 103 glaucomatous patients and Group B: 103 Non glaucomatous patients].

There was no statistical significant difference between the two groups in terms of male and female. In the group A, 55.30% were male and 44.70% were female while in the group B, 47.60% were male and 52.40% female.

The mean age of patients of group A (57.36±14.05) was significantly higher than the mean age of patients of group B (41.28±17.00). It was evident as maximum participants (68.00%) in group A were of more than 50 years of age

while in the group B maximum patients (64.00%) were from 20-50 years age group.

Qureshi (1995)[8] reported that IOP increases with age by a factor of 0.28 mm hg every 10 years. He also reported that the magnitude of the difference keeps on increasing after 40 years of age.

With regards to Best Corrected Visual Acuity (BCVA) for right eye, it was found that in group A 6/60, 6/36, 6/12 and 6/24 were most prevalent (25.20%, 10.70%, 10.70% and 9.70% respectively) while in group B 6/6, 6/60 and 6/9 were most prevalent (29.10%, 19.40% and 15.50%) and this difference between both the groups was statistically significant.

In the Best Corrected Visual Acuity (BCVA) for left eye, it was found that in group A 6/60, 6/36, 6/18, 6/12 and 6/24 were most prevalent (12.60%, 12.60%, 12.60% 11.70% and 11.70% respectively) while in group B 6/6, 6/9, 6/12 and 6/18 were most prevalent (34.00%, 12.60%, 11.70% and 10.70%) and this difference between both the groups was also significant.

Population screening for glaucoma based mainly on IOP, may not be necessarily identifying all patients due to variable response of the human eye to the changing IOP. Although multiple risk factors can account for the susceptibility to glaucomatous damage, the IOP is the only risk factor that is amenable to treatment by pharmacological and surgical measures.[9,10] Baseline values of the IOP will help the clinician in monitoring progress of the disease and response to treatment.[11] In this study, when measured with Goldmann Applanation Tonometer (GAT), it was found that mean IOP of both right and left eye in group A (24.19±12.94 and 23.34±13.73 respectively) was significantly higher than mean IOP of both right and left eye in group B (15.06±2.49 and 15.12±2.38 respectively). Likewise, when measured with Schiotz tonometer (ST), mean IOP of both right and left eye in group A (26.05±11.93 and 24.65±12.28 respectively) were very significantly higher in comparison to group B (16.79±2.64 and 16.85±2.47 respectively).

The mean pressure obtained by the Schiotz tonometer was higher than the mean Goldmann pressure which indicates that the Schiotz tonometer tends to read higher than the Goldmann tonometer. Several other studies in past compared IOP measurements obtained with GAT and those obtained by noncontact tonometers.[12–14] Firat et al. (2012)[12] study concluded that non-contact tonometer measurements were higher than those obtained by GATs and that this difference was statistically significant. Martinez-de-la-Casa et al. (2011)[13] compared IOP measurements obtained with GATs and with non-contact tonometers and found that the mean GAT measurement was lower than the mean non-contact tonometer measurement. Tonnu et al. (2005)[14] showed that the mean difference in IOP between GAT measurements and AP tonometer measurements was 0.7 mmHg.

The present study showed the mean difference for right eye of group A, was 1.86±6.28 mmHg and 1.73±0.91mm Hg for group B and for the left eye of group A, it was 1.31±7.39 mmHg and 1.74±0.88 mmHg for the two devices. This difference was non-significant.

To assess the consistency of different tonometers for giving reliable results, the study was done for both the eyes. This study is the assessment of consistency or reproducibility of (IOP) measurements made by different instruments. In this study, the difference in mean IOP when measured with GAT and ST was found to be non-significant for both eyes. To find the reliability match with the gold standard technique, a Bland–Altman plot analysis is made. This is a type of data plotting used for analyzing the agreement between two different investigations under study.

In this study, it was found that the mean IOPs measured through GAT and ST were very significantly positively correlated but the readings value was not clustered around the mean 0 line, so the values between the ST and GAT are not so coherent. Hence, GAT and ST are not in agreement. Our study results support other studies which have found that Schiotz tonometer have a low agreement with GAT.[15,16] In addition, Schiotz tonometry is performed in the supine position, which could rise the IOP, contributing to the low agreement.[17]

The central corneal thickness (CCT) was also taken into consideration. For right eye in group A (517.14±40.83), it was significantly lower than group B (528.30±33.37) while no significant difference was there in the left eye. In the Bland–Altman plot analysis, it was found that the measurements plotted are clustered around the mean 0 line, so the values between the CCT and GAT are coherent. Both of these are in good agreement.
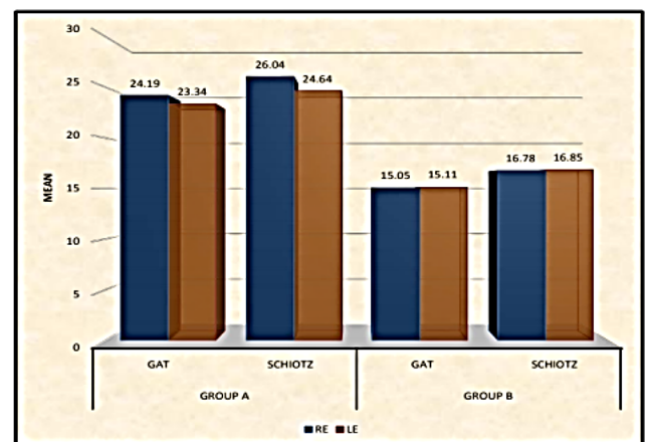


**Fig. 2:**

## 4. Discussion

Our study was aimed to comparing IOP measurement by Schiotz and GAT and was done at J.L.N. medical college

and associated group of hospital. A total of 206 patients were enrolled in the study which were further grouped as Group A (103 glaucomatous patients) and Group B(103 non-glaucomatous patients). All patients were subjected to IOP measurement by two tonometers namely Schiotz and Goldmann applanation.

The study concluded that, in group A there were 55.30% were male and 44.70% female and in group B 47.60% were male and 52.40% female. The mean age of patients of group A (57.36±14.05) was statistically significantly higher than the mean age of patients of group B (41.28±17.00).

The IOP of group A was statistically significantly higher than group B when measured with both Schiotz and Goldmann tonometers. Also, the mean pressures obtained by the Schiotz tonometer were higher than the mean Goldmann pressures.

In the Bland–Altman plot analysis, it was found that Schiotz and Goldmann tonometers were not in agreement while Goldmann tonometers and Central corneal thickness were in good agreement.

## 5. Conclusion

For early detection of glaucoma, it is recommended that those above the age of 40 years of age coming to eye OPD should be screened properly. However, Limitation of resources and poor access to specialized ophthalmic services may justify the use of a more economical Schiotz tonometer along with evaluation of the optic disc as the screening test for glaucoma. The highest specificity seen with Schiotz tonometer in this study indicates that this tonometer can be recommended as a reliable screening tool in community outreach ophthalmology services. However, it is required that those patients with a provisional diagnosis of abnormal IOP must be further subjected to GAT for confirmation and follow up.

## 6. Source of Funding

Authors do not have any financial interest

## 7. Conflict of Interest

None.

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