

Goldmann Applanation Tonometer Vs Schiottz Tonometer in Measuring Intraocular Pressure

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Abstract:

Background: Glaucoma is a common cause of permanent vision loss worldwide, ranking second after cataracts. Around 40 million people aged 40 and older either have glaucoma or are at risk of developing it. Assessing the performance and reliability of various tonometers in diverse settings is crucial for optimizing glaucoma detection and management, especially in resource-limited environments.

Objective:

1. To compare the efficacy of Schiottz and goldmann applanation tonometer

Materials and Methods: 50 patients were included. This cross sectional study was done in the Department of Ophthalmology at Santhiram Medical College, Nandyal, Andhra Pradesh, India. Male and females aged above 40 years with newly diagnosed glaucoma were included.

Results: Most of the patients belonged to the age group 51 to 60 years (50%), followed by 41 to 50 years (28%). 70% of the patients were females. Mean IOP was 24.7mm as measured by Goldmanns tonometer and it was 23.9 mm as measured by Schiottz. The sensitivity of Goldmann tonometer in detecting glaucoma was 86.49%, specificity was 57.14%, and diagnostic accuracy was 80%. The sensitivity of schiottz tonometer in detecting glaucoma was 88.89%, specificity was 71.47%, and diagnostic accuracy was 88%.

Conclusion: Schiottz tonometry produced comparable results with Goldmann applanation tonometry, showing good specificity and reliability in detecting positives, serving as a viable screening tool.

Keywords: Glaucoma, Intraocular pressure, Schiottz tonometer, Goldmann tonometer, Vision loss

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I. INTRODUCTION

Glaucoma is a common cause of permanent vision loss worldwide, ranking second after cataracts.¹ Around 40 million people aged 40 and older either have glaucoma or are at risk of developing it.² Intraocular pressure (IOP) is a main risk factor which can be modified in glaucoma. Clinical trials have shown that even a slight increase in IOP can lead to damage to the visual field and progression of the disease. Therefore, precise measurement of IOP is important for predicting and monitoring disease progression.³⁻⁴

Ophthalmologists rely on accurate techniques to detect glaucoma early.

Glaucoma ranks as 2nd most common cause of irreversible vision loss worldwide, with prevalence in South India ranging from 1.62% to 2.6%.⁵⁻⁶ It is characterized by chronic optic neuropathy involving structural and functional changes in optic nerve head, where elevated intraocular pressure (IOP) is a significant risk factor. Normal IOP is crucial for maintaining ocular shape and visual function, as prolonged elevation can lead to irreversible damage to retinal ganglion cells and nerve fibers.⁷ Accurate measurement of IOP not only guides treatment initiation but also monitors treatment effectiveness.⁸

Advancements in tonometry instrumentation over recent decades aim to enhance the accuracy of IOP measurement, yet ocular and non-ocular factors can complicate measurements and treatment.⁹ In India, public health institutions, particularly those serving underprivileged communities, rely heavily on rural camps for population-wide screening of vision disorders. In these settings, cost-effectiveness of tonometers play a crucial role in device selection. Often, due to limited manpower, optometrists perform rapid IOP measurements, raising questions about the accuracy of cheaper, user-friendly tonometers.

Assessing the performance and reliability of various tonometers in diverse settings is crucial for optimizing glaucoma detection and management, especially in resource-limited environments.

Objective:

To compare the efficacy of Schiottz and goldmann applanation tonometer

II. MATERIALS AND METHODS

STUDY DESIGN: Comparative study

Source of study population: Patients with Glaucoma attending ophthalmology unit at Santhiram Medical College, Nandyal, Andhra Pradesh

STUDY PERIOD: 12 months

SAMPLE SIZE: 50

Ethical approval: Informed consent was taken from every participant.

INCLUSION CRITERIA:

1. Patients aged above 40 years
2. Both genders
3. Newly diagnosed glaucoma patients

EXCLUSION CRITERIA

1. Patients taking treatment for glaucoma
- Patients with scarred or hazy cornea
 Patients who underwent corneal surgeries like refractive surgery, Blepharospary, microphthalmos, Nystagmus, Keratoconus
 Patients having corneal infections.

Methodology:

Ocular examination began with assessing visual acuity using Snellen charts for literate patients and C charts for illiterate patients, both with and without pinhole correction. Refractive error was determined using retinoscopy and auto-refractometry. The examination covered the conjunctiva, sclera, cornea, iris, pupil, anterior chamber, lens, posterior chamber, and posterior segment of each patient's eye.

Each participant received two types of tonometry: Goldmann Applanation tonometry and Schiottz Indentation tonometry. Topical anesthesia was given using 0.5% proparacaine eye drops before the tonometry procedure. Goldmann Applanation tonometry readings were taken first, followed by Schiottz Indentation tonometry. Three consecutive readings were obtained for each eye using each method, and the average of these readings was recorded as the intraocular pressure (IOP).

Statistical analysis: Analysis was done using Microsoft software. Mean, SD, percentages, and frequencies were used.

III. RESULTS

Age and gender:

Most of the patients belonged to the age group 51 to 60 years(50%), followed by 41 to 50 years(28%). 70% of the patients were females.

AGE	No. of Patients	Percentage
41 TO 50	14	28%
51 TO 60	25	50%
ABOVE 60 YEARS	11	22%
Total	50	100%

Table 1: Age distribution of patients

Mean age was 53 years.

IOP mean: Mean IOP was 24.7mm as measured by Goldmanns tonometer and it was 23.9 mm as measured by Schiottz.

PARAMETERS	GOLDMANN	SCHIOTZ
MEAN IOP	24.7±2.6	23.9±1.4 MM OF HG

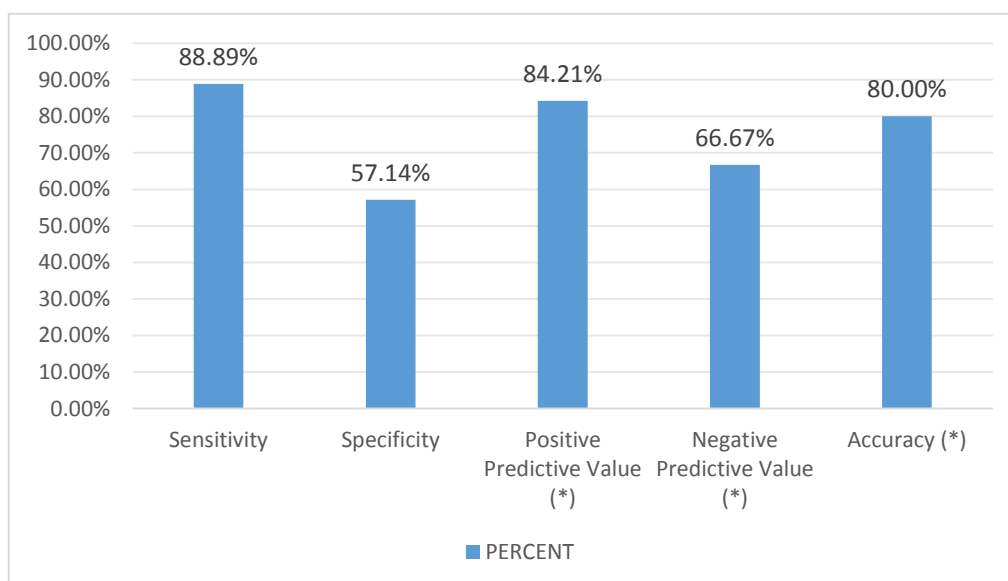
Table 2: Mean IOP measured by both methods

Sensitivity, specificity, diagnostic accuracy of Goldmann tonometer:

There were 8 true negative cases, 5 false negative cases, 5 false positive cases and 32 true positive cases. The sensitivity of Goldmann tonometer in detecting glaucoma was 86.49%, specificity was 57.14%, and diagnostic accuracy was 80%.

Statistic	Value	95% CI
Sensitivity	88.89%	73.94% to 96.89%
Specificity	57.14%	28.86% to 82.34%
Positive Likelihood Ratio	2.07	1.12 to 3.84
Negative Likelihood Ratio	0.19	0.07 to 0.54
Disease prevalence (*)	72.00%	57.51% to 83.77%
Positive Predictive Value (*)	84.21%	74.23% to 90.80%
Negative Predictive Value (*)	66.67%	41.67% to 84.84%
Accuracy (*)	80.00%	66.28% to 89.97%

Table 3: Accuracy of Goldmann tonometer



Graph 1: Accuracy of Goldmann tonometer

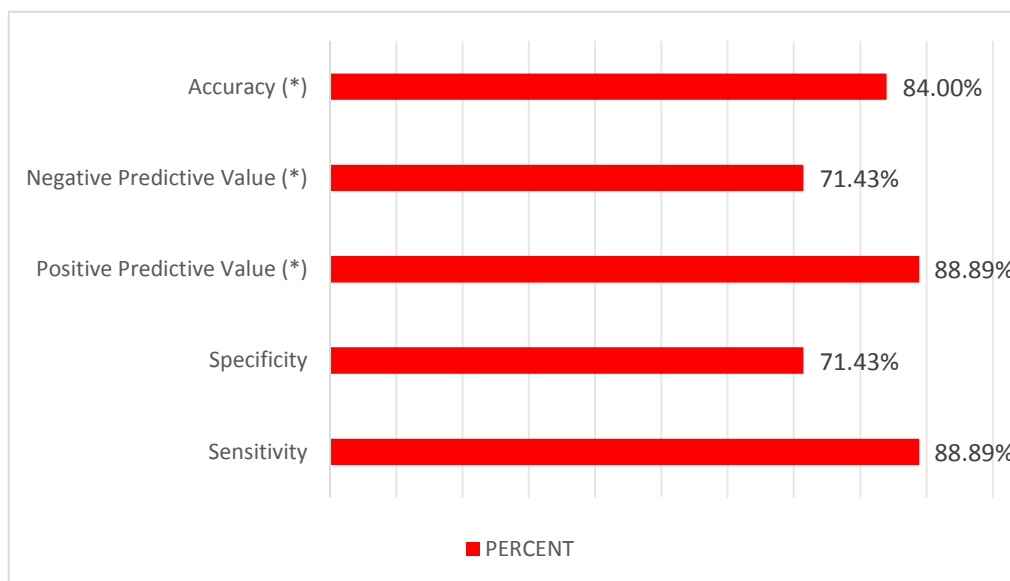
Sensitivity, specificity, diagnostic accuracy of Schiottz tonometer:

There were 10 true negative cases, 4 false negative cases, 4 false positive cases and 32 true positive cases. The sensitivity of schiottz tonometer in detecting glaucoma was 88.89%, specificity was 71.47%, and diagnostic accuracy was 88%.

Statistic	Value	95% CI
Sensitivity	88.89%	73.94% to 96.89%
Specificity	71.43%	41.90% to 91.61%
Positive Likelihood Ratio	3.11	1.35 to 7.18
Negative Likelihood Ratio	0.16	0.06 to 0.42
Disease prevalence (*)	72.00%	57.51% to 83.77%
Positive Predictive Value (*)	88.89%	77.61% to 94.86%

Negative Predictive Value (*)	71.43%	48.37% to 86.96%
Accuracy (*)	84.00%	70.89% to 92.83%

Table 4: Accuracy of Schiottz tonometer



Graph 2: Accuracy of Schiottz tonometer

IV. DISCUSSION

Glaucoma is a multifactorial disease that causes optic nerve damage, which is characterized by specific structural changes in optic disc and functional deficits in visual field testing.¹⁰

Increased IOP can cause irreversible damage to ganglion cells and nerve fibers, emphasizing the importance of accurate IOP detection for initiating and monitoring treatment.

This comparative study was done on intraocular pressure measurement using Goldmann applanation tonometry (GAT) versus Schiottz tonometry (ST) as a screening tool in South Indian population, 50 patients were examined. Most of the patients belonged to the age group 51 to 60 years (50%), followed by 41 to 50 years (28%). 70% of the patients were females. Mean IOP was 24.7mm as measured by Goldmann's tonometer and it was 23.9 mm as measured by Schiottz. The sensitivity of Goldmann tonometer in detecting glaucoma was 86.49%, specificity was 57.14%, and diagnostic accuracy was 80%. The sensitivity of Schiottz tonometer in detecting glaucoma was 88.89%, specificity was 71.47%, and diagnostic accuracy was 88%. In the study of **Munaff et al.**¹² who published a study in 2024.

Most of the patients were aged between 40-50 years, followed by 51-60 years, 61-70 years, and Goldmann findings showed specificity of 52% and sensitivity of 95.3%, and ST showed specificity of 54% and sensitivity of 97.2%. PPV was 80.1% for GAT and 82.3% for ST, and NPV was 89.2% for GAT and 90.8% for ST. These results are consistent with studies done by **Foster, Ouyang, Allingham et al.**¹³⁻¹⁵

In spite of being gold standard, GAT shows intra- and inter-reader variability and may not be suitable in few clinical settings, like operating rooms or primary care by general practitioners.¹⁶

ST, though providing a range rather than a precise measurement, tends to read lower than GAT by about 1.2 mm Hg, mentioning the role in detecting abnormal IOP.¹⁷⁻¹⁸

Limitations:

Relatively small sample size

Lack of access to the latest technologies

Correlation between Goldmann and Schiottz findings were not done.

There are no conflicts of interest to declare, and the study was self-funded.

V. CONCLUSION

Schiottz tonometry produced comparable results with Goldmann applanation tonometry, showing good specificity and reliability in detecting positives, serving as a viable screening tool. It could be especially useful in primary health centers for monitoring IOP in established glaucoma cases, with GAT reserved for confirmation and follow-up in cases of abnormal findings.

The study is self-sponsored.
There were no conflicts of interest.

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