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Investigating The Schiotz Tonometer As A Screening Tool And Comparing It To The Goldmann Application Tonometer For Intraocular Pressure

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ABSTRACT

Anatomical abnormalities in the optic disc and automated visual field testing may identify glaucoma, a disease that attacks the optic nerve. For treatment to be effective, accurate measurement of intraocular pressure is required. Increased intraocular pressure harms the optic nerve head, which may lead to visual field loss and progressive optic neuropathy in individuals with normotensive glaucoma. If you're looking for a screening tool, consider the Goldmann applanation tonometer or the Schiotz tonometer, both of which are popular in developing nations. Two hundred and ten patients of varying weights participated in the research. We found the intraocular pressure by averaging three measurements geometrically. Although it had low screening performance, the Schiotz tonometer was shown to be quite accurate. The research found that the Schiotz tonometer is a fair screening tool since it consistently detects positives and has adequate specificity, which is in line with what the Goldmann applanation tonometer finds. Primary care clinics may employ Goldmann applanation tonometers, visual field exams, and examinations of the optic nerve head to monitor intraocular pressure in patients with confirmed glaucoma who have provisional diagnoses of abnormal intraocular pressure.

Keywords : Goldmann applanation tonometer, Schiotz indentation tonometer, screening tool.

I.INTRODUCTION

Globally, glaucoma is second only to cataract in terms of the frequency of blindness, and it is the primary cause of permanent blindness. Glaucoma is thought to affect 3.54 percent of the world's population. India has an estimated 309 million people aged 40 and more, with almost 40 million of those people suffering with glaucoma or at risk for getting the condition.

Glaucoma is now understood to be a progressive optic neuropathy caused by several risk factors, rather than simply increased intraocular pressure as was previously thought.

Among the many risk factors for glaucoma, intraocular pressure stands out as the only one that can be changed. Evidence from many large-scale clinical studies suggests that elevated intraocular pressure (IOP) may cause damage to the visual field and the onset and advancement of glaucoma. Predicting and monitoring the course of illness relies heavily on accurate and precise measurements of intraocular pressure.

This is why it's so important to identify instances and suspected of glaucoma very away. The problem, however, is that public awareness is low and detection rates are low.

Ophthalmologists may detect instances and screen suspects from the general population with the use of intraocular pressure measurements taken at the primary healthcare level in conjunction with examinations of the optic nerve head and visual fields. The Goldmann applanation tonometer is a complicated tool to use during screening, yet it is the gold standard for measuring intraocular pressure.

Because of its affordability, mobility, and user-friendliness, Schiotz indentation tonometers are now the screening choice most often used in underdeveloped countries. There are a lot of patients who need to be examined at big eye camps, and cleaning between patients is a pain, therefore it's not surprising that this tonometer is deemed unreliable.

Numerous, pricey portable tonometers have been developed to overcome the shortcomings of the Schiotz tonometer in response to developments in glaucoma treatment.

This research seeks to examine the Schiotz tonometer's reliability and usefulness as a screening tool in comparison to the Goldmann applanation tonometer.

AIMS AND OBJECTIVES

1. With the aim of contrasting the results obtained from the Goldmann applanation tonometer and the Schiotz indentation tonometer in terms of intraocular pressure.
2. To investigate the validity of the Schiotz indentation tonometer in detecting glaucoma in large populations.

II. REVIEW OF LITERATURE

The optic nerve is one of the many targets of the multi-factorial illness known as glaucoma. The diagnostic criteria for this optic neuropathy include abnormalities in automated visual field tests and certain anatomical findings in the optic disc, such as an elevated Vertical Cup Disc Ratio (VCDR) or VCDR asymmetry more than the 97.5 percentile.

Maintaining proper eye shape and visual function depends on maintaining a normal intraocular pressure (IOP). Prolonged elevation of IOP causes permanent damage to the retinal ganglion cells and postganglionic nerve fiber. Initiating and tracking the efficacy of therapy both depend on accurate detection of intraocular pressure.

Contrasting tonometry with intraocular manometry, which involves cannulating the anterior chamber of the eye, is the gold standard for determining a tonometer's accuracy. But this is difficult in human research with a big sample size. Consider the other approach of benchmarking all tonometers against the Goldmann applanation tonometer.

The Goldmann applanation tonometer is considered the gold standard, although it does have significant variability across readers and even within them. On the other hand, it can't be influenced by the erroneous results that indentation tonometers may produce due to aberrant ocular stiffness. Because of its inherent difficulty, it should not be used on bedridden patients, in operating rooms, or by primary care physicians who screen a large number of cases due to their workload.

THE SCHIOTZ TONOMETER –

The tonometer that Prof. Schiotz developed was based on the idea that every eye responds in the same way to indentation. But this might only be a guess, as the distensibility of each eye is different. Alternatively stated, the ocular stiffness coefficient (K) differed among the various eyes. Actually, the average K value was used to construct Friedenwald's conversion tables, and eyes that differ from this average K value tend to provide incorrect IOP readings.
Actually, the 1915 publications of Smith and McClean show that the Schiotz tonometer is not very precise; it predicts intraocular pressure (IOP) with considerable precision, but it may read as much as 5 mm Hg lower than the manometrically recorded IOP.15,16 Goldmann and Schimdt pointed out that the mathematical and metrological basis of the Schiotz tonometer was inadequate, considering that Friedenwald had produced three separate conversion tables using the same numerical data from 1948 onwards. In an effort to determine whether the Goldmann applanation tonometer or the Schiotz tonometer was more accurately calibrated, Anderson and Grant tried both. There was a stronger correlation between the results from the Goldmann tonometer and the 1948 calibration table than with the more popular 1955 one, and the Goldmann tonometer generally gave higher values than the Schiotz tonometer.

Another problem with the Schiotz tonometer was that it was hard to get very precise readings since the pointer would pulsate around half a millimeter to one millimeter when the patient was moving about while the scale was being recorded. If the pointer's location on the scale is even half a millimeter off, the wrong value—14,18—would be taken as the actual intraocular pressure.
The poor reliability of the Schiotz tonometer was shown by Jackson's finding that only 40% of applanation measurements were within the Schiotz range of intraocular pressure readings obtained with the 5.5g weight. Eighty percent of the applanation values fell between the 3 mmHg to 5 mmHg Schiotz range, and 95% fell within the same range. Readings between applanation and Schiotz were increasingly erratic as the subject's weight increased, he noted. His research led him to the conclusion that the Schiotz tonometer could not detect intraocular pressure (IOP) precisely, but rather within a range of pressures.

Twenty children with developing and secondary glaucomas, ranging in age from one month to seventeen years, were studied under general anesthesia by Lasseck et al., who compared Schiotz tonometry with intraocular tonometry. With a variation of 17% and a coefficient of determination of

0.60, the Schiotz tonometer was shown to have a significant range of outliers. They used intraocular manometry as the gold standard since Goldmann applanation tonometry proved difficult to perform on youngsters. Furthermore, it was noted that the Schiotz tonometer has the tendency to underestimate intraocular pressure (IOP) in eyes affected by corneal disease, in comparison to intraocular manometry. Gharaei et al. conducted comparable studies on 74 children's eyes under general anesthesia in Iran. In conjunction with the Schiotz tonometer and the Friedenwald conversion tables from 1955, they used weights of 5.5, 7.5, and 10g. They were curious as to whether the Schiotz and applanation tonometers could be used interchangeably, especially when not in a clinical setting. Results from the Schiotz tonometer for intraocular pressure were found to be both greater and more varied than previously thought. The Schiotz tonometer seems to outperform even the Goldmann applanation tonometer in eyes that had underwent corneal refractive surgery. The flourescein dye would pool and distort when the applanation head made contact with these corneas due to their irregularity. On the other hand, a study done on 175 of these eyes by Rosa et al. showed that the 5.5g Schiotz tonometer was more precise. We compared intraocular pressure (IOP) readings collected with a Goldmann applanation tonometer before surgery to those taken three months after surgery using a Schiotz tonometer and two different weights, 5.5 and 10 grams. While the Goldmann applanation tonometer was more accurate than the Schiotz tonometer in post-operative patients, the IOP was still underestimated, especially with the 10g weight, and the underestimating was worsened by the degree of treatment. Furthermore, it should not be done to measure intraocular pressure (IOP) in healthy eyes using the Schiotz tonometer since it is a primitive method with a significant possibility of inaccuracy. On the other hand, it could complement other methods.

ANATOMY OF THE ANTERIOR CHAMBER ANGLE

The angle is the region of the anterior chamber where the edges of the chamber meet. A sloping anterior border meets the peripheral cornea and a sharp posterior border produces the scleral spur; it is situated on the inner side of the limbus and is called the scleral sulcus or the limbus groove. The Schlemm's canal is formed when the trabecular meshwork crosses the scleral sulcus. These structures in the angle of the eye make form the trabecular duct for aqueous drainage.
The band created by the anterior side of the ciliary body, which is peripheral to the iris root insertion, serves as the most posterior marker of the angle. There are ciliary muscle fibers therein, and they insert longitudinally into the scleral spur.
A scleral spur is a raised ridge on the rear of the scleral sulcus that is wedge-shaped. The corneoscleral portion of the trabecular meshwork attaches posteriorly to it, and the longitudinal fibers of the ciliary muscle enter into it. The corneoscleral component of the trabecular meshwork is posteriorly linked to it, and it is also the site of insertion of the longitudinal fibers of the ciliary muscle. In addition, it contains scleral spur cells that contain actin and myosin, making them similar to myofibroblasts. According to the theory, these cells change the trabecular structure, which in turn affects the outflow resistance.

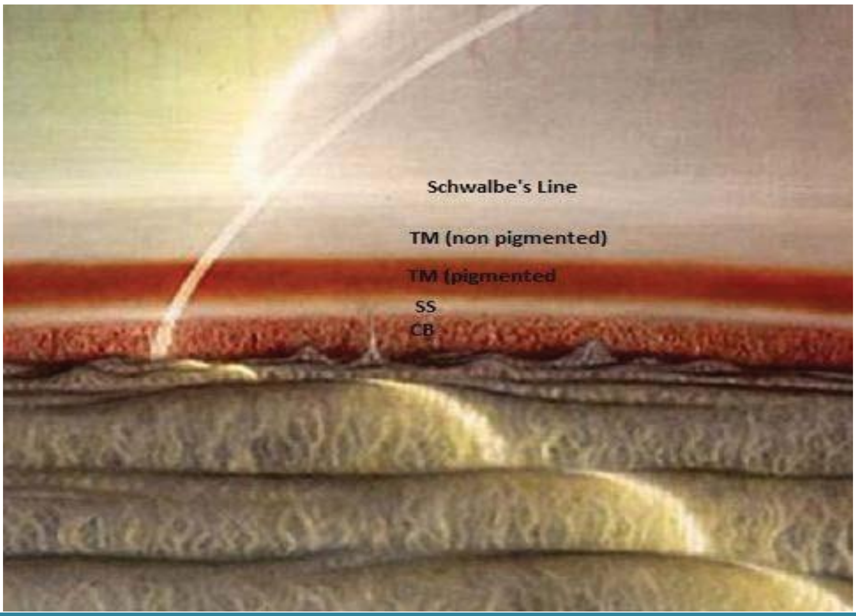


Fig. No. 1: Gonioscopic appearance of a normal angle of the anterior chamber. TM- trabecular meshwoork. SS – scleral spur. CB – ciliary body band.

Schwalbe's ring / Schwalbe's line: Its front boundary. To illustrate this, we may look at Zone S, a flat area just before the top of the trabecular meshwork. At the front margin of Zone S, the Descemet's membrane terminates peripherally, and the trabecular endothelium transforms into corneal endothelium. The posterior margin is formed by inserting the uveal trabeculae into the stroma near the limbus.

The trabecular meshwork: Extending posteriorly from the scleral spur and iris root and anteriorly from the Schwalbe's line, it is composed of many layers of perforated sheets of connective tissue. The colored area next to Schlemm's canal is the non-functional, non-filtering component of the trabecular meshwork, while the non-pigmented area ahead of the canal is the functional, filtering half.

The trabecular meshwork consists of three distinct layers of tissue:

1. The innermost uveal meshwork, which stretches from the base of the iris to the Schwalbe's line, has the biggest intertrabecular gaps (25-75 µ), which do not provide much barrier to the outflow of water.
2. Between the scleral spur and the anterior wall of the scleral sulcus lies the intermediate corneoscleral meshwork, which has elliptical voids that progressively reduce in size from the center outward (5-50).
3. The juxtacanalicular meshwork or outermost endothelium that encases Schlemm's canal.
4. Juxtacanalicular meshwork endothelium is continuous with corneoscleral meshwork endothelium on the inner aspect, with a connective tissue layer separating it from the outer endothelium. On the outside, the endothelium forms the wall of Schlemm's canal. The defining features of these cells are wide spaces between them, projecting nuclei, big vacuoles, and finger-like projections into the lumen. Despite these openings, the juxtacanalicular tissue's outflow pathways are the most convoluted and glycoprotein and proteoglycan dense, resulting in the greatest outflow resistance.

THE PATHWAYS OF UNCONVENTIONAL OUTFLOW

Two such pathways have been described

- Through the interstitial gaps of the ciliary muscle, water flows from the base of the iris to the suprachoroidal space in the uveoscleral outflow channel. Finally, it reaches the episcleral tissues either directly via the sclera's material or via the pores that carry the nerves and blood vessels.
- A small waterway leading from the anterior choroid and ciliary muscle arteries to the vortex veins is known as the uveovortex outflow channel.

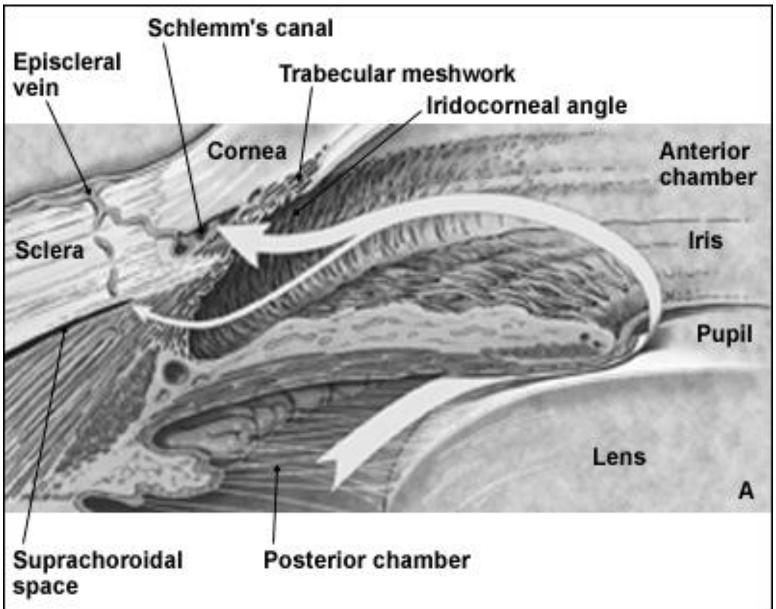


Fig. No. 2: The aqueous outflow pathways: thick arrow – the conventional pathway, thin arrow – the uveoscleral pathway.

INTRAOCULAR PRESSURE AND THE FACTORSINFLUENCING IT

Several parameters, including the rate of aqueous production, the facility of outflow, the episcleral venous pressure, and the resistance to outflow, influence the rates of aqueous influx and outflow, which in turn determine the intraocular pressure. The Goldmann equation summarizes the link between these parameters and the IOP -

$$P_0 = (F/C) + P_v$$

where P_0 is the IOP in millimeters of mercury

F is the microliter per minute rate of aqueous formation. In microliters per minute per millimeter of mercury, C is the capability of aqueous outflow. and

P_v is the episcleral venous pressure in millimeters of mercury.

Resistance to outflow is the reciprocal of C.

APPLANATION TONOMETERS

By flattening the eye, these tonometers distort it. One way to measure intraocular pressure (IOP) is with a fixed area tonometer, which measures the force needed to flatten a certain area, or with a fixed force tonometer, which measures the area flattened by said force. The formulas for both of these, however, are variations on the Imbert-Fick law, which asserts that the force acting on a spherical object is equal to its internal pressure times the area that it flattens. Adjustments were needed to account for the cornea's lack of flexibility, asphericity, and wetness since the law stipulated that the sphere had to be precisely spherical, dry, infinitesimally thin, and absolutely flexible.

Maklakoff created the first applanation tonometer that could be used in clinical settings; it was a fixed force tonometer that measured intraocular pressure (IOP) by measuring the amount of fluid that was displaced when the eye was subjected to a constant force. Clinical usage of this tonometer has ceased.

THE GOLDMANN APPLANATION TONOMETER:

In 1888, Fick created the Goldmann Applanation tonometer, a fixed area tonometer that is still the gold standard and the most dependable tonometer ever made. Using a plastic biprism as the applanation device, the instrument consists of a housing with a slit light attached on it. By applanating a 3.06 mm diameter region on the cornea's exterior, the biprism creates an applanation area of 7.35mm on the cornea's inner surface. Optical beam splitting biprism divides the applanation region into two semicircles, which overlap when the cornea flattens down by 3.06 mm.

Procedure: After a topical anesthetic and sodium fluorescein have been administered, the patient is positioned comfortably before a slit lamp, with both eyes in primary gaze. The plastic biprism is gently brought into touch with the cornea under cobalt blue light, and the meniscus of the tear film, which has been dyed with fluorescein, may be seen as two semicircles through the prism. To get the intraocular pressure (IOP) reading from the tonometer, turn the force knob on the housing until the inner semicircles contact. If the pulse pressure is causing the mires to oscillate, then averaging the excursions will yield the correct result.

Sources of error: The first calibration of the tonometer was based on the assumption that the corneal thickness was 0.5mm. Researchers have discovered that the thickness of the cornea affects the intraocular pressure (IOP) measurement; larger corneas lead to inflated IOP measurements, and the IOP increases by around 0.19 mmHg for every 10μm increase in central corneal thickness. Underestimation of intraocular pressure (IOP) occurs because to the substantial thinning of the corneas that occurs after refractive surgery.

The thickness of the menisci also alters the IOP reading with wider menisci causing the read IOP to be falsely higher. Vertical mal alignment of the semicircles also causes false elevation of the IOP value.

Falsely low Goldmann IOP values are common in cases with abnormal corneal elasticity, such as edematous or scarred corneas.

The Goldmann Applanation tonometer remains the most reliable tool despite its many flaws. These days, most people use handheld, portable tonometers like the ones made by Perkins and Draeger. They're great for patients who can't get out of bed or who are in the operating room since they work as well on both sides of the body.

Disinfection: Because it involves physical contact, tonometry has the inherent danger of transmitting infectious diseases from patient to patient. Because of the potential for the spread of infectious diseases like HIV and hepatitis B, disinfection is an essential component of every medical operation.

Seventy percent isopropyl alcohol, five percent hydrogen peroxide, or five percent sodium hypochlorite is what the American Academy of Ophthalmology suggests immersing the tonometer head in for five minutes. Alternatively, you may use 70% isopropyl alcohol to wipe the tip. To minimize corneal toxicity, be sure to fully remove the disinfectant from the contact surface before using it again.

THE NON-CONTACT TONOMETER:

Similar to the Goldmann tonometer, this one employs an air puff to applanate a consistent and well-known region of the cornea. When the cornea flattens, it reflects light like a plane mirror, which a receiver picks up on. In this step, a microprocessor takes the area applanated and the force needed to applanate the cornea, and it digitally displays the intraocular pressure (IOP).

A vertical, horizontal, and axial alignment system for the cornea is part of the device, as is a pneumatic system for producing a puff of ambient air and a monitoring system for shining light into the cornea and collecting its reflected light in parallel beams.

Procedure: Seated and looking inward, the patient undergoes the treatment. By using a stationary ring to superimpose the target's reflection on the patient's cornea, the operator is able to align the cornea. When the eye's cornea is in the correct position, the operator inflates it by pressing a button. After adjusting the alignment to center, the X-pert NCT and Keeler Pulsair EasyEye Tonometer will automatically activate the air puff.

Sources of error: Corneal thickness and surface imperfections impact non-contact tonometry in the same way they do the Goldmann applanation tonometer.

Due to the irrationality of the air puff in relation to the stages of the cardiac cycle, the ocular pulse becomes a major variable, leading to low dependability with few observations. For that reason, you should take an average of at least three measurements that are within 3 mm Hg.

Fig. No. 3: The Keeler Pulsair EasyEye non contact tonometer.

Disinfection: Since the non-contact tonometer does not touch the surface of the eye, there is not need to worry about disinfection while using it. But there's been concern that the tear film that's released after air impact would contaminate the portion of the device that faces the patient.

OCULAR RESPONSE ANALYZER:

When measuring intraocular pressure (IOP), the cornea's biomechanical characteristics have a role. While much research on corneal thickness has taken place, the Reichert Ocular Response Analyzer (ORA) allowed researchers to finally take corneal viscosity and elasticity into account. It uses an air puff to distort the cornea and then measures the resulting changes in its physical characteristics. The cornea's viscoelastic qualities generate corneal hysteresis, a delay in the inward and outward applanation events caused by the absorption of energy from the air impulse.

To further compress the cornea to a little concavity, a carefully metered collimated air pulse is used for applanation. When the air pump stops working during applanation, the cornea returns to its previous shape and goes through a second outward applanation. Two applanation values are produced by the viscous corneal damping, which is caused by the air pulse's dynamic nature and the cornea's viscoelastic characteristics; this delay occurs between the inward and outward applanation. The Goldmann-correlated intraocular pressure (IOPG) is calculated as the mean of these readings, and corneal hysteresis is shown by the difference between them. Using data on the cornea's elasticity and viscosity, cornea compensated intraocular pressure (IOPCC) estimates the cornea's deformability.

Corneal thickness affects intraocular pressure (IOP) measurements taken with the ORA in the same way it does with other tonometers. There has been no comparison to intraocular manometry using the tonometer, hence its absolute accuracy is uncertain.

When compared to other tonometers, the ORA stands out for its ability to measure corneal deformability. This property could be useful in the diagnosis of corneal diseases such as keratoconus and Fuch's endothelial dystrophy, as well as in the screening of patients undergoing refractive surgery for the possibility of post-LASIK ectasia.

DYNAMIC OBSERVING TONOMETRY:

One diagnostic tool that can measure intraocular pressure (IOP), show the anterior chamber angle, and see the posterior pole of the fundus all at once is the dynamic observing tonometer, popularly known as the SmartLens. The lens's body has a piezo-electric pressure sensor that records IOP over time, and the contact surface features a 2.5 mm diameter central applanation zone. The instrument has a decent track record of dependability, but the method is difficult to learn and has poor reliability amongst observers..[47]

INDENTATION TONOMETERS

To measure intraocular pressure, indentation tonometers press down on the cornea with a predetermined force, creating a truncated cone shape. Eyes with higher intraocular pressures resist indentation to a larger extent than eyes with lower pressures; the degree to which an indentation occurs is therefore dependent on this pressure. To determine the intraocular pressure (IOP), conversion tables are required since indentation causes a substantial movement of intraocular fluid.

A certain amount of intraocular fluid is displaced whenever the tonometer makes an indentation in the cornea. When the pressure changes, the eye's volume changes in a linear logarithmic fashion. The coefficient of ocular stiffness (K), an indication of the eye's distensibility, is a numerical constant in the formula that Friedenwald established for this. In 1948, he created a conversion table using an estimated K value of 0.0245. In 1955, he made some changes to the K value and made a new conversion table. The new value is 0.0215. The 1948 tables were found to be more accurate when compared with the Goldmann applanation tonometer.

The device is made out of a metal plunger that goes down a metal shaft and terminates in a concave footplate that is meant to mimic the normal curvature of the cornea. The degree of indentation is shown by the needle riding on the top of the plunger, which goes along a scale. The needle travels one unit on the scale for every 0.05mm movement of the plunger. There is a 5.5g weight that is permanently connected to the plunger. You may adjust the indentation weight from 7.5g to 10g or 15g with the included loose weights.

Procedure: Once the topical anaesthetic drops have been applied, the examiner will carefully draw the patient's eyelids back while they lie supine, being sure not to push on the globe. Before gently lowering the footplate of the Schiotz tonometer over the cornea's central region, the patient is asked to stare into primary gaze. Using the weight referenced in the conversion nomogram, the amount of deflection of the scale needle is recorded and translated into intraocular pressure (IOP). If ocular pulsations cause the needle to wander, the average reading between the wanderings must be considered as the scale reading.

Fig. No. 4: The Schiotz indentation tonometer

Since the lower end of the scale compresses larger IOP readings, any number below 3 indicates that IOP is greater than usual but does not provide an accurate picture of the IOP. It is important to note the IOP with the greater weights in these cases.
Potential error causes: Schiotz based his nomograms on an average scleral stiffness value when he first presented the tonometer, assuming that all eyes had a comparable ocular rigidity. However, this is not always the case, because myopic eyes that are less inflexible allow for a greater degree of indentation, leading to a proportionate underestimating of the intraocular pressure (IOP). If anything, the intraocular pressure (IOP) is overstated in hyperopic eyes and those that have corneal scarring. The intraocular pressure (IOP) reading could be affected by the removal of intraocular blood during the operation.

According to the American Academy of Ophthalmology, you should disinfect the tonometer after each use by removing the plunger from the shaft and washing it individually.

COMBINED INDENTATION APPLANATION TONOMETERSTHE MACKAY-MARG TONOMETER:

A miniature plunger with a diameter of 1.5 mm extends from a sleeve with a diameter of 3 mm; this is linked to a sensitive transducer, which records the displacement of the plunger as an electric signal on paper.
When the plunger's entire 1.5 mm diameter makes contact with the cornea, the trace starts to climb and reaches a peak. The force that bends the cornea is transmitted to the sleeve when the plunger is flush with it, and the tracing dips to a trough. Additional flattening causes an increase in intraocular pressure (IOP), which is seen as an additional rise in the tracing. From the baseline to the trough is where the IOP is measured.

TONOPEN:

The Mackay-Marg tonometer model serves as the basis for this handheld, portable tonometer.

Its integrated CPU finds many valid waveforms, averages them, and then displays the result digitally. It further shows the percentage of variation between the two extreme values.

Scarred, uneven, or oedematous corneas, particularly those that have had keratoplasty, may be effectively treated with the TonoPen. Plus, it's one of the few tonometers that work with contact lenses. Disinfecting is a breeze since each usage only requires a new disposable latex cap for the tip.

THE PNEUMATIC TONOMETER:

This tonometer measures intraocular pressure (IOP) by sensing changes in air pressure, much as the Mackay-Marg tonometer. This portable pen-shaped gadget uses pressurized air to expel itself from a core chamber contained inside a nozzle covered by a membrane. An electrical transducer takes the air pressure—which is dependent on the resistance to its exhaust—and uses it to create a trace on a paper strip.

The trace starts to climb as the area of corneal contact grows when the nozzle meets the cornea, and it continues to do so until the flattened cornea's area is equal to the central chamber's size. The intraocular pressure (IOP) and the amount of force needed to bend the cornea are both shown by the tracing's height. As the cornea is further compressed, the bending force is transferred to the nozzle, causing the trace to descend to a trough that stands for intraocular pressure (IOP).11

Pneumatic tonometers distort the cornea and dispense a huge volume of intraocular fluid, which makes them partially indentation tonometers, even though they are intended as applanation tonometers.

Typically, it gives Goldmann IOP readings that are 2-4 mm Hg too high.

DYNAMIC CONTOUR TONOMETRY

In contrast to the applanation and indentation tonometers discussed so far, this innovative device operates on a completely new premise. The idea is based on the fact that when an object's shape matches that of a sphere, the pressure outside the sphere will be equal to the pressure within.

A dynamic contour tonometer has a cylindrical tip that mimics the shape of the cornea very closely. It rests on the cornea with a continuous force of 1g and has a radius of curvature of 10.5mm. The contact surface has a diameter of 7mm. Approximately 100 times per minute, the 1.2 mm piezoelectric sensor at the tip monitors the intraocular pressure. During the cardiac cycle, the intraocular pressure (IOP) is measured during both the systolic and diastolic periods. The Ocular Pulse Amplitude (OPA) measures the choroidal perfusion by comparing the systolic and diastolic intraocular pressures.

You may see the diastolic intraocular pressure (IOP) in millimeters of mercury (mm Hg), the open blood pressure (OPA) in millimeters of mercury (mm Hg), and the quality score (Q) all digitally on a liquid crystal display. The Q score ranges from 1 (excellent measurement) to 5 (bad measurement), with 1 being the best and 5 the worst. An indication of the readings' dependability is given by it.

Corneal variations, such as thickness or the presence or absence of post–refractive surgery, have less of an impact on the dynamic contour tonometer. No studies have examined its reliability in corneas with scars, oedematous corneas, or uneven surfaces. The dynamic contour tonometer has great potential in the treatment of glaucoma and ocular hypertension, while research into its practical applications is ongoing.

THE REBOUND TONOMETER

Rebound tonometers are portable instruments that measure the bouncing motion of an item after it hits the cornea. Although Obbink first brought up this notion in 1931, it failed to generate much enthusiasm at the time.

In 1997, the iCARE tonometer—the one that is now in use—was released. It makes use of a plastic-capped, magnetic stainless steel wire probe with a 0.9 mm radius. The instrument's probe contacts the cornea in its center when a button is pushed, and a microprocessor records the deceleration of the probe at that point. As the intraocular pressure (IOP) rises, the effect time decreases. seven

Research has shown that the tonometer exaggerates the Goldmann intraocular pressure (IOP) by about 1.34 mm Hg.

III. MATERIALS AND METHODS

SOURCE OF THE DATA: Participants in this research were employed who were seen during business hours by the ophthalmology outpatient department at Khaja Banda Nawaz teaching and general hospital.

METHOD OF COLLECTION OF DATA:

- Study type – Prospective comparative study
- Duration of study – eighteen months
- Sample size – 210 patients were selected by purposive sampling in keeping withthe inclusion and exclusion criteria.

INCLUSION CRITERIA:

1. Patients who are above 40 years of age and give their consent for the study.

EXCLUSION CRITERIA:

1. Patients who are less than 40 years of age and those who do not give their consent for the study.
2. Patients on anti-glaucoma treatment.
3. Scarred or hazy corneas.
4. History of previous corneal surgery including refractive surgery.
5. Microphthalmos.
6. Blepharospasm.
7. Manifest nystagmus.
8. Keratoconus.
9. Any current conjunctival or corneal infections

Using a pre-designed proforma, data was gathered after obtaining written informed permission.

Using Snellen's chart for literate patients and Landolt's C chart for illiterate patients, a thorough ocular examination was performed, which included the measurement of visual acuity with and without a pin hole. In order to detect refractive error, autorefractometry and retinoscopy will be used. We looked at the front and back chambers as well as the sclera, cornea, iris, pupil, and lens.

After that, under topical anesthesia with 0.5% proparacaine eye drops, each patient underwent two types of tonometry: Goldmann applanation tonometry and Schiotz indentation tonometry. Both the Goldmann's applanation and Schiotz indentation tonometers were used to measure the readings. The intraocular pressure was determined by taking three consecutive measurements for each eye using each technique. The average value was then used.

PROCEDURE OF GOLDMANN APPLANATION TONOMETRY:

After inserting 0.5% topical proparacaine eye drops, the precorneal tear film was stained using strips soaked with 0.6 mg sodium fluorescein.
Every last drop of tear was dabbed away.

Once the patient had a quick rundown of the process, they were sent to sit under the slit light.
The applanation apparatus's force knob was set to 1 and the cobalt blue filter was turned on. While the patient was in main gaze, the applanation head was advanced until it just touched the cornea. The patient was asked to stare straight ahead as the applanation head was moved forward until it touched the cornea. Viewed via the applanation biprism, the force knob was adjusted until the inner borders of the semicircles of the fluorescein stained tear film barely touched. A measurement was made using the force knob's scale, and then the result was converted to mm Hg by multiplying it by 10. The technique was repeated three times for each eye, starting with the right eye and ending with the left eye. A total of six readings were recorded. If the semicircles were too thick or narrow, the readings were disregarded.

METHOD OF DATA ANALYSIS:

The IBM SPSS 25.0 version software was used for data analysis. A master chart was created once the collected data was spread out on an Excel page. Graphs and tables were made with the help of the master chart. When analyzing quantitative data, descriptive statistics like mean and standard deviation were first calculated. To compare the means of two variables, an independent samples "t" test was used. When comparing more than two variables, an ANOVA test was utilized to determine statistical significance. A chi-square test was used to determine statistical significance in qualitative data analysis, with a significance level of $P < 0.05$ being applied to all comparisons.

IV. RESULTS

Table 2: Age wise distribution of patients

Age groups in years	Number of patients	Percentage
40—50	113	53.7
51—60	56	26.7
61—70	31	14.8
71—80	8	3.8
>80	2	1
Total	210	100.0
Mean ± SD	52.94 ± 10.04	-----

Simple bar diagram represents age wise distribution of patients

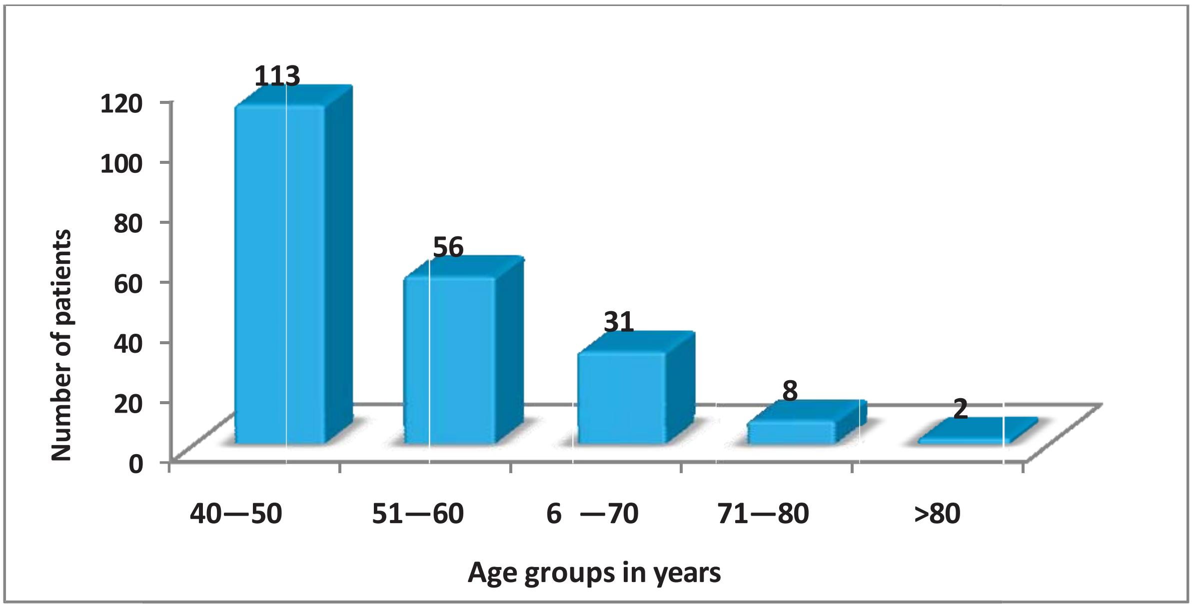
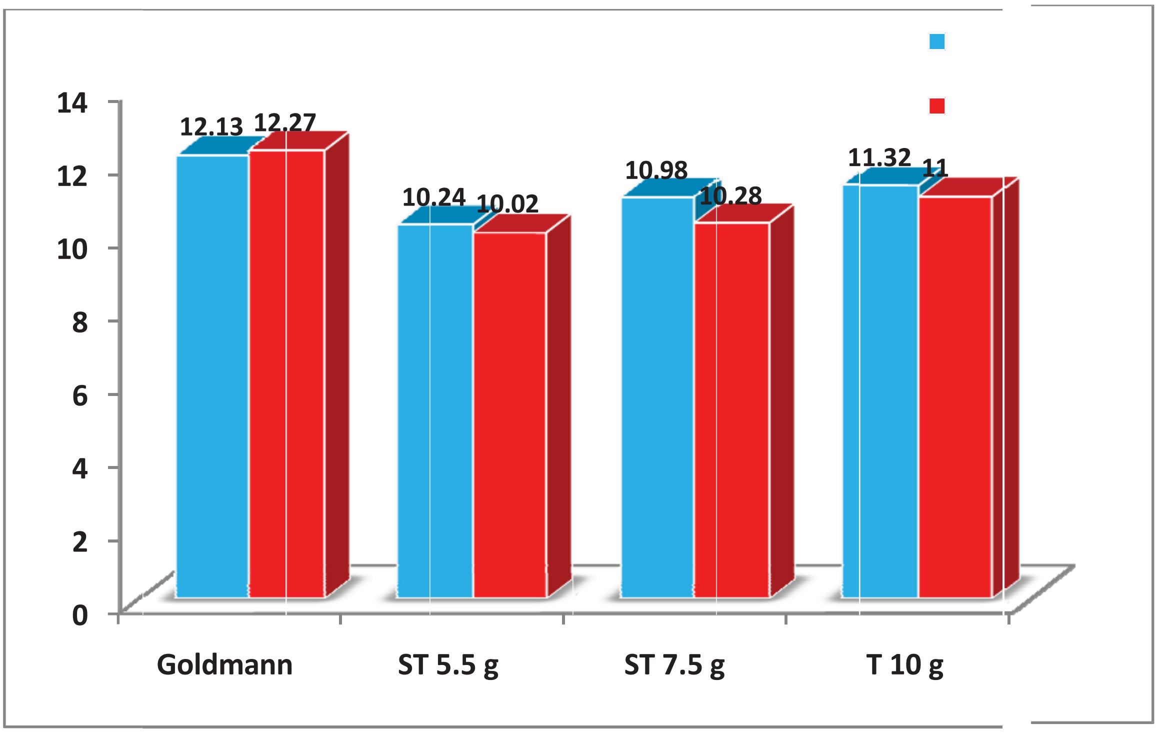


Table 3 : Mean and standard deviation of Goldmann Applanation Tonometer and Schiotz Tonometers between each eye

Tonometers		Minimum value	Maximum value	Mean	Std. deviation
Goldmann	OD average	8.52	20.00	12.27	2.64
	OS average	7.83	19.33	12.13	2.89
ST 5.5 g	OD average	6.13	18.63	10.02	2.16
	OS average	7.13	15.13	10.24	1.90
ST 7.5 g	OD average	8.63	13.56	10.28	2.07
	OS average	7.26	14.33	10.98	2.28
ST 10 g	OD average	7.79	18.00	11.01	1.99
	OS average	8.13	15.63	11.32	2.39

Bar diagram representing comparison of Goldmann Applanation Tonometer and Schiotz Tonomete



Tab le 4: Comparison of Schiotz Tonometer with 5.5g, 7.5g and 10 g

Variables	ST 5.5g	ST 7.5g	ST 10 g	ANOVA test and P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
OS average	10.24± 1.90	10.98± 2.28	11.32± 2.39	F = 1.036, P = 0.356 NS
OD average	10.02± 2.16	10.28± 2.07	11.01± 1.99	F = 1.312, P = 0.307 NS

Component bar diagram represents comparison of Schiotz Tonometer with 5.5g, 7.5g and 10g

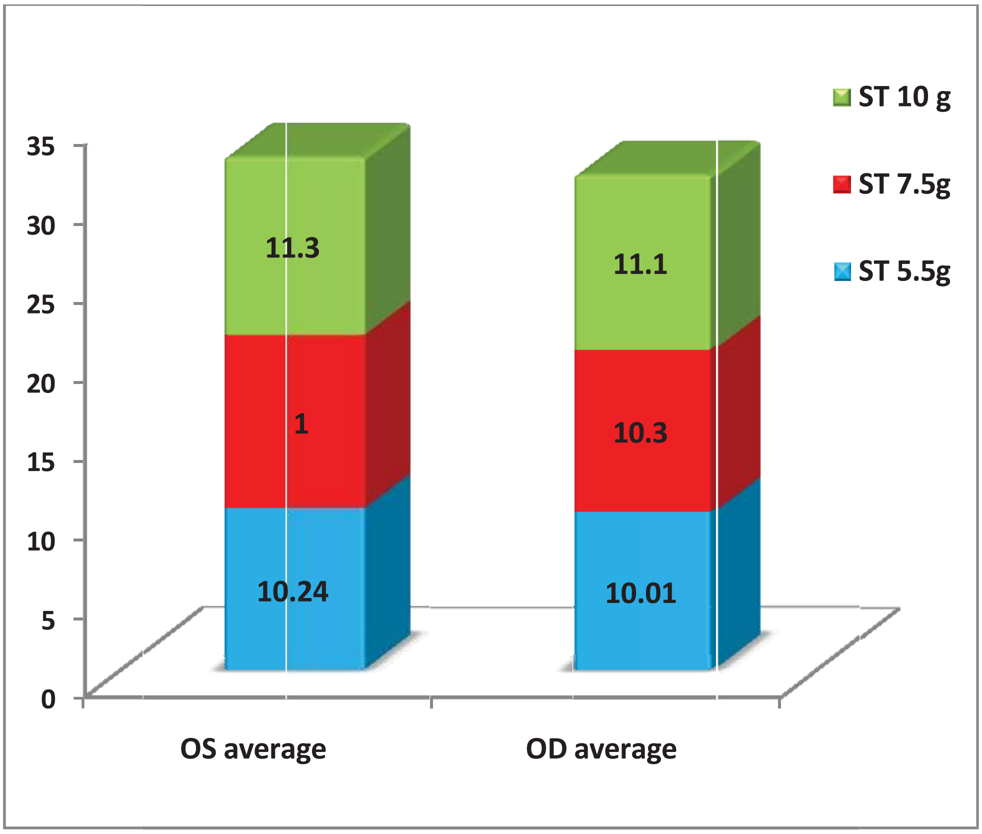


Table 5: Correlation of GAT and Schiotz Tonometers

Correlation	Correlation coefficient	P-value
GAT v/s ST 5.5g	r = 0.321	P < 0.05
GAT v/s ST 7.5g	r = 0.360	P < 0.05
GAT v/s ST 10g	r = 0.425	P < 0.05

Study reveals that; there was statistically significant correlation between GAT with ST 5.5 g, ST 7.5 g and ST 10 g (P<0.05)

Table No.6: Sensitivity and Specificity of GAT and Schiotz Tonometers

Sensitivity	52.0%
Specificity	95.3%
Positive predictive value	80.1%
Negative predictive value	89.2%

In comparison to the Goldmann applanation tonometer, the Schiotz tonometer had good sensitivity and excellent specificity. With strong positive and negative predictive values. Therefore, the Schiotz tonometer is not a good screening tool since it produces few false positive findings but many false negative ones due to its low sensitivity.

DISCUSSION

Multiple factors contribute to glaucoma, but the optic nerve is a typical target. Autonomic visual field tests certain functional abnormalities and specific anatomical findings in the optic disc (e.g., an elevated Vertical Cup Disc Ratio [VCDR] or VCDR asymmetry >97.5 percentile) indicate optic neuropathy. The optic nerve head, vision field, and intraocular pressure make it up. A glaucomatous eye does not always have elevated intraocular pressure, although this is a common association. The diagnosis of glaucoma requires injury to the optic nerve head and the subsequent loss of visual field. Maintaining proper eye shape and visual function depends on maintaining a normal intraocular pressure (IOP). Prolonged elevation of IOP causes permanent damage to the retinal ganglion cells and postganglionic nerve fiber. Initiating therapy and tracking the efficacy of treatment both depend on accurate detection of intraocular pressure. Normotensive glaucoma patients show that elevated intraocular pressure is not necessary for the development of visual field loss and degenerative optic neuropathy. But it has been shown that increased intraocular pressure damages the optic nerve head, and lowering it has slowed the damage's development. There is a wide variety of tonometers on the market today, but it is important that the one used for screening be practical for usage in screening settings, such as primary eye care providers and camps.

This study aimed –

- This research aimed to compare the Schiotz tonometer to the industry-standard Goldmann applanation tonometer.
- In order to determine the validity of the Schiotz tonometer in screening.

Goldmann applanation and indentation tonometry were the two forms of tonometry administered to the 210 research participants. Three measurements were collected with each tonometer, starting with the right eye and moving on to the left, in order to get the mathematical mean.

The data was analyzed using the intra-class correlation coefficient (ICC), a statistical metric, to determine the correlation between the study tonometers and the gold standard. It was believed that the intra-class correlation coefficient was more appropriate than the t test for this research. Though it provides a statistically significant result for the difference between the two test techniques, the t test does not account for the differences between the study and test measures on an individual basis; instead, it provides a general notion. When comparing results from the study technique and the test method side by side, the intra-class correlation coefficient determines how well the two sets of data agree with one another.

The Schiotz indentation tonometer versus the Goldmann applanation tonometer: The intraocular pressure (IOP) readings given by the Goldmann applanation tonometer and the Schiotz tonometer were so different that Jackson could only determine a range of values for the IOP using the former.

This investigation verified his results by showing that there were statistically significant differences between the Goldmann applanation tonometer and the Schiotz tonometer with all three weights in both eyes (p values of 0.0).

When compared to the gold standard, the tonometer showed a little more positive results from the ICC.

In addition, consistent with earlier research, the average pressures measured by the Schiotz tonometer were around 1-2 mm Hg lower than the average pressures measured by the Goldmann tonometer.

This investigation confirms previous findings that the Schiotz tonometer is in good agreement with the Goldmann applanation tonometer. It reliably detected positives while eliminating false positives and had acceptable specificity. As a result of its high false negative rate, the Schiotz tonometer was unable to identify real instances due to its low sensitivity.

As a result, it seems like a reasonable screening instrument. Patients with a provisional diagnosis of abnormal intraocular pressure (IOP) should undergo a Goldmann applanation tonometer examination, in addition to visual feels and examination of the optic nerve head, for confirmation and follow-up; this device can be used in primary health centers to roughly monitor IOP in known cases of glaucoma.

SUMMARY

In order to determine the Schiotz tonometer's validity as a screening tool, the research set out to compare it to the present gold standard tonometer, the Goldmann applanation tonometer.

The aforementioned tonometry procedures were applied to 210 subjects, 103 of whom were female and 107 of whom were male, ranging in age from 40 to 85.

This investigation confirms previous findings that the Schiotz tonometer is in good agreement with the Goldmann applanation tonometer. Despite its great precision, the Schiotz tonometer was not very sensitive. It reliably detected positives while eliminating false positives and had acceptable specificity. As a result, it seems like a reasonable screening instrument. Patients with a provisional diagnosis of abnormal intraocular pressure (IOP) should undergo a Goldmann applanation tonometer examination, in addition to visual feels and examination of the optic nerve head, for confirmation and follow-up; this device can be used in primary health centers to roughly monitor IOP in known cases of glaucoma.

V. CONCLUSION

This investigation confirms previous findings that the Schiotz tonometer is in good agreement with the Goldmann applanation tonometer. It reliably detected positives while eliminating false positives and had acceptable specificity. As a result, it seems like a reasonable screening instrument. Patients with a provisional diagnosis of abnormal intraocular pressure (IOP) should undergo a Goldmann applanation tonometer examination, in addition to visual feels and examination of the optic nerve head, for confirmation and follow-up; this device can be used in primary health centers to roughly monitor IOP in known cases of glaucoma.

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