

Comparison of the corrected intraocular pressure by tonopachy with that of Goldmann applanation tonometry in normal and glaucomatous patients

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Purpose: To compare corrected intraocular pressure (IOP) by tonopachy with that of Goldmann applanation tonometry (GAT) in normal and glaucomatous patients. **Methods:** In this cross-sectional study, IOP and central corneal thickness (CCT) were measured in 426 eyes (213 normal eyes and 213 glaucomatous eyes) of 426 patients by tonopachy followed by GAT and ultrasound pachymetry. IOP was corrected for CCT by in-built formula in tonopachy and Ehlers correction factor for Goldmann tonometer. Limits of agreements were assessed using Bland–Altman plots. Intraclass correlation coefficient was calculated to estimate the absolute agreement between single and average measurements of IOP and CCT of tonopachy with that of Goldmann tonometer and ultrasound pachymetry respectively. **Results:** Mean corrected IOP measured with tonopachy and GAT in glaucomatous eyes was 17.63 ± 5.04 mmHg and 19.42 ± 5.83 mmHg, and in controls it was 13.4 ± 2.5 mmHg and 16.2 ± 3.1 mmHg, respectively. Limits of agreement ranged from -4.63 to $+9.25$ mmHg for total population (mean = 2.31), -6.01 to $+9.59$ mmHg (mean = 1.79) for glaucoma group and -2.99 to $+8.65$ mmHg (mean = 2.83) for controls. Intraclass correlation coefficient for IOP measurement between tonopachy and Goldmann tonometer was 0.84 for total population, 0.85 for glaucoma group, and 0.63 for controls, respectively. **Conclusion:** Corrected IOP obtained by tonopachy showed moderate agreement with GAT and it is more in glaucoma patients than controls. Thus, tonopachy can be used as a screening tool, but cannot replace GAT.

Key words: Agreement, central corneal thickness, Goldmann applanation tonometer, intraocular pressure, tonopachy

Intraocular pressure (IOP) is the only modifiable risk factor in the treatment of glaucoma.^[1] Early successful treatment of elevated IOP can prevent optic nerve damage and blindness.^[2] Goldmann applanation tonometer (GAT), based on the Imbert-Fick law, is considered the clinical gold standard for IOP measurement.^[3-7] Most of our current understanding of the treatment of glaucoma is based on GAT readings.

Applanation tonometry is a contact procedure. It requires topical anesthesia and fluorescein staining and has certain limitations to its use, like need for technical expertise and it is a time-consuming procedure.^[8] Also as an indirect measure of the IOP, GAT outputs can be affected by the central corneal thickness (CCT) and other biomechanical properties of cornea.^[9] A thin or thick cornea can underestimate or overestimate IOP.^[10,11] Accordingly, there is a need to adjust IOP values taking CCT into consideration, for it may change the treatment decisions and affect patient outcomes.^[12,13] Several nomograms have been developed for adjusting GAT readings for varying CCT; however, these nomograms are not consistently accurate.^[12-14] It is expected that IOP is affected by CCT, but the exact numerical correction factor to account for CCT is uncertain.^[15]

There is a need to develop and introduce different instruments to measure IOP. In recent years, various devices

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have been designed with the intention of being minimally influenced by the individual eye characteristics and to provide non-contact IOP assessment. Each method, however, has been shown to have its own technical limitations like the need for longer applanation period for dynamic contour tonometry, etc.^[16] Since the introduction of non-contact tonometry (NCT), IOP can be measured without the use of anesthesia. The NCT is a simple and objective method of IOP measurement which can be performed by ancillary staff and hence employed as a screening tool.^[17]

A newly developed non-contact tonopachymeter: Tonopachy™ (NT-530P, NIDEK Co., LTD, Gamagori, Japan) is a unique system that has two simultaneous functions, one is as a NCT for the measurement of IOP which can reduce the possible risk of transmission of infectious diseases, and the other is as a non-contact pachymeter for measuring CCT.^[18-20] The principle of IOP measurement by tonopachy is based on the ejection of an air pulse to the corneal surface similar to NCT and the measurement of CCT is based on the principle of the Scheimpflug camera.^[21-24] Thus, it measures the IOP and

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CCT in a single shot without topical anesthesia. It can also calculate the corrected IOP with an in-built formula that uses the measurement data of CCT.^[25] These measurements are operator independent due to the auto-alignment function of the instrument.^[20] The automatic shut-off mechanism minimizes the subject's discomfort.^[4] It is thus expected to offer a simple, time saving and useful method for the simultaneous assessment of IOP and CCT for glaucomatous screening.

When a new instrument becomes available, it is important to compare its accuracy to that of a well-established method and to assess repeatability of its measurements. Few studies^[18-20,26] have compared the efficacy of the tonopachy and GAT. These studies have been conducted in small samples and have been performed on healthy eyes with a normal IOP range. To our knowledge, the efficacy of tonopachy has not yet been studied in glaucomatous population. Thus, this study was undertaken in order to evaluate the efficacy of tonopachy in a wider range of IOP including glaucomatous eyes and to assess its level of agreement with the known gold standard of IOP and CCT measurement, that is, GAT and ultrasound pachymetry respectively. If proven useful, tonopachy can be considered for screening IOP and CCT in a high volume set up.

Methods

This study was approved by the Institutional Review board as well as the Ethical committee and followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all the patients after explanation of the study's purpose, methods, and expected outcomes. Patients were also assured that their refusal to take part in the study would not compromise their treatment.

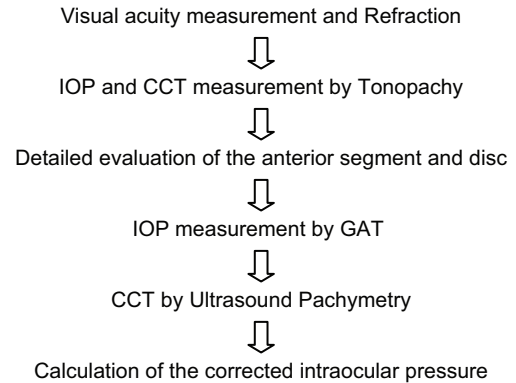
Study population

Study participants consisted of patients visiting the glaucoma services and normal individuals (without ophthalmic disease except for refractive error \pm 3D spherical/cylindrical error and presbyopia) presenting to the general ophthalmology services at a tertiary eye hospital in south India over a period of 10 months from March 2013 to January 2014.

Glaucoma group consisted of newly diagnosed patients of primary open angle glaucoma (POAG), primary angle closure glaucoma (PACG), and pseudoexfoliation glaucoma (PXF). Patients were excluded if (1) diagnosed as glaucoma suspects, ocular hypertensives (OHT), normal tension glaucoma (NTG), secondary glaucomas (except for PXF), primary angle closure (PAC), and primary angle closure suspects (PACS); (2) refractive error of more than \pm 6D sphere and astigmatism of more than 3D; (3) history of contact lens use in the preceding week or any ocular surgery; (4) corneal pathology; (4) ocular comorbidities other than glaucoma; (5) unable to cooperate; and (6) monocular.

POAG was defined as IOP \geq 22 mmHg, open angles on gonioscopy along with glaucomatous disc changes (cup disc ratio \geq 0.6, notch, thinning of neuroretinal rim). PACG was defined as IOP \geq 22 mmHg, closed angles on gonioscopy (trabecular meshwork could not be visualized for 180° or more) along with glaucomatous disc changes. Presence of pseudoexfoliation (PXF), IOP \geq 22 mmHg, open or closed angles on gonioscopy along with glaucomatous disc changes constituted PXF glaucoma.

Ocular evaluation



Once the patient qualified for inclusion in the study (after screening by GV), the detailed assessment of all study participants was done at glaucoma services prior to administration of mydriatic eye drops. It consisted of measurement of best corrected Snellen's distant visual acuity by trained technicians. After tonopachy evaluation, one of the investigators (SK, RV) did the slit-lamp biomicroscopic evaluation of the anterior segment, undilated evaluation of the optic disc using slit lamp and 90 dioptre lens, applanation tonometry, gonioscopy examination with the Goldmann 2 mirror gonioscopes followed by dilated fundus evaluation using 90 dioptre lens. On the day of recruitment, each study participant underwent the following tests, in the following order:

Tonopachy™ (NT-530P; Nidek Co., LTD, Gamagori, Japan) readings: A single trained technician with experience in using the tonopachy instrument measured IOP and CCT. Patient was asked to keep the forehead against the forehead rest and look at the fixation target. Three CCT and three IOP readings were obtained and the instrument automatically averaged each of the three CCT and three IOP readings. The IOP reading thus obtained was corrected automatically by an algorithm in built in the tonopachy.

GAT (AT-900; Haag-Streit International, Koeniz, Switzerland) readings: Two IOP readings were obtained before pupillary dilation by one of the study investigators (SK, RV) using the slit-lamp mounted GAT in a masked manner. 0.5% Proparacaine was used as the topical anesthetic and the eye was stained with sterile wetted fluorescein strip. A magnification of 10× on the slit lamp was used with cobalt blue filter to detect end points. A technician set the drum dial to an arbitrary number between 5 and 25 mmHg. The study investigator (SK, RV) applanated by applying varying amounts of mechanical pressure to obtain the end point and result was recorded by the technician. Average of the two IOP readings was considered and it was corrected for CCT as per the corrections suggested by Ehlers *et al.*^[27]

Ultrasound pachymetry (300P Pacscan, Sonomed Escalon) readings: Patient was asked to fixate on a target. Following instillation of the topical anesthetic 0.5% Proparacaine, the pachymeter probe was gently aligned as perpendicularly as possible to the central cornea. Five CCT readings were obtained by the study investigator (SK, RV) and the automatically generated average value displayed on the screen was used as CCT. If the standard deviation of CCT was >10 μ m, all measurements were repeated.

In accordance with the previous studies,^[28] the non-contact method tonopachy was performed first followed by GAT after 10 min interval. This order was followed to avoid possible reduction in IOP as a result of forced aqueous massage during the process of indentation with GAT.^[28] Both, the ophthalmic technician performing tonopachy and the study investigators performing the GAT and ultrasound pachymetry were masked to readings by the other instrument as well as the glaucoma status of the patient. All the IOP and CCT readings by tonopachy were recorded by the same ophthalmic technician. Similarly, the same study investigators measured the IOP by GAT and CCT by ultrasound pachymetry to avoid inter-observer bias. All measurements were done during office hours only. All the instruments used in the study were calibrated once in 2 weeks prior to data collection.

Statistical analysis

Using a pilot sample of 30 subjects, a sample size of 426 subjects (213 normal and 213 glaucomatous subjects) was selected to allow for standard deviation (SD) of 7.2 in the glaucoma group and 6.8 in the control group with a mean difference of 1.9 between the two groups, based on type I error probability of 0.05 and a power of 0.8.

Four hundred twenty-six eyes of 426 patients, consisting of 213 eyes as controls and 213 glaucomatous eyes were analyzed in the study. The right eyes of the study participants in both the groups were analyzed.

Uncorrected IOP obtained by the two devices was compared first followed by comparison of CCT corrected IOP. Descriptive statistics were used to report demographic characteristics. Chi-square test was used for categorical variables to evaluate group differences. Bland-Altman plots were used to assess the limits of agreements (LoA) and their 95% confidence interval between tonopachy and GAT measurements of IOP, and between CCT measurements obtained with the tonopachy and ultrasound pachymetry. The intraclass correlation coefficient (ICC) was calculated in order to estimate the absolute agreement between single and average measurements of IOP and CCT taken with the tonopachy and the GAT and ultrasound pachymetry respectively. The difference between corrected IOP measurements using the GAT and tonopachy (Δ IOP) for each eye was calculated and factors predicting Δ IOP were assessed using multivariable linear regression analysis adjusted for age and gender. Baseline IOP and glaucoma diagnosis were not included due to likely significant collinearity. $P < 0.05$ was considered statistically significant. All analysis was conducted using STATA version 11.1 (StataCorp, College Station, TX).

Results

Patients with glaucoma were significantly older (58.7 ± 10.9 years) than controls (49.5 ± 8.7 years) ($P < 0.001$). There was no significant difference in the gender distribution

between the groups ($P = 0.327$; Table 1). Out of 213 glaucomatous eyes: 140 (65.73%) were POAG, 40 were (18.78%) PACG, and 33 (15.49%) were PXFG.

The mean uncorrected IOP for the total population measured with the tonopachy and GAT was 15.09 ± 4.42 mmHg [Range (R) = 10–35 mmHg] and 16.64 ± 4.80 mmHg (R = 10–36 mmHg), respectively.

In controls, the mean uncorrected IOP measured with the tonopachy was 12.93 ± 1.89 mmHg (R=10–20 mmHg) as compared to 14.92 ± 2.79 mmHg (R = 10–24 mmHg) with GAT ($P < 0.001$; Table 2). In the glaucoma group, the mean uncorrected IOP with the tonopachy was 17.25 ± 5.13 mmHg (R = 10–35 mmHg) as compared to 18.35 ± 5.71 mmHg (R = 10–36 mmHg) with GAT ($P < 0.001$; Table 2).

The CCT corrected IOP was 15.51 ± 4.52 mmHg (R = 6.42–39.02 mmHg) and 17.82 ± 4.94 mmHg (R = 10–39 mmHg) with tonopachy and GAT respectively for the total population ($P < 0.001$; Table 3). In the control group, the mean corrected IOP measured with the tonopachy was 13.4 ± 2.5 mmHg (R = 6.42–22.36 mmHg) compared to 16.22 ± 3.13 mmHg (R=10–24 mmHg) with GAT ($P < 0.001$; Table 3). In the glaucoma group, the mean corrected IOP measured with the tonopachy was 17.63 ± 5.04 mmHg (R = 7.78–39.02 mmHg) as compared to 19.42 ± 5.83 mmHg (R = 10–40 mmHg) with GAT respectively ($P < 0.001$; Table 3).

Tonopachy underestimated corrected IOP compared to GAT in both the controls and glaucoma patients by about 2 mmHg and the difference was statistically significant ($P < 0.001$). Also there was statistically significant difference between the IOP readings obtained in the glaucoma group and controls ($P < 0.001$; Independent *t*-test).

The Bland-Altman plot analysis for corrected IOP showed that the mean IOP difference was 2.31 and the 95% limits of agreement ranged from -4.63 to +9.25 mmHg for the total population, -6.01 to +9.59 mmHg (mean = 1.79) for the glaucoma group and -2.99 to +8.65 mmHg (mean = 2.83) for the normal group [Figs. 1-3]. The LOWESS curve was smoother for all the groups [Figs. 4-6]. The Intraclass correlation (ICC) for IOP measurement between tonopachy and GAT was 0.84 for the total population, 0.85 for the glaucoma group, and 0.63 for the normal group, respectively. ICC shows that these two methods of IOP measurement correlate but the Bland-Altman plot indicate that they have moderate agreement. In 64.5% (275) of the eyes studied, the mean IOP difference between tonopachy and GAT was less than 3 mmHg [Table 4]. After correcting for age, Δ IOP was significantly greater with higher baseline GAT IOP (2.08 mmHg increase with every 5 mmHg increase in baseline GAT IOP) and higher in study participants with glaucoma compared to controls (Δ IOP = 2.59 mmHg higher in glaucoma subjects) [Table 5]. There was a significant difference

Table 1: Demographic characteristics

Group	n	Mean age (SD)	P	Gender	P
Glaucoma	213	58.68 (10.96)	<0.001 [†]	Males: 117 (54.9%) Females: 96 (45.1%)	0.327 [°]
Normal	213	49.51 (8.73)		Males: 127 (59.6%) Females: 86 (40.4%)	
Total	426	54.09 (10.91)	-	Males: 244 (57.3%) Females: 182 (42.7%)	-

[†]t-test. [°]Chi-square test

between the uncorrected and corrected IOP by both tonopachy and GAT ($P < 0.05$ for all; Tables 6 and 7).

The mean CCT measured with the tonopachy and ultrasound pachymetry for the total population was $533.54 \pm 35.70 \mu\text{m}$ and $528.63 \pm 34.42 \mu\text{m}$, respectively, for the glaucoma group, was $534.51 \pm 36.26 \mu\text{m}$ and $530.09 \pm 34.38 \mu\text{m}$, respectively, and for the controls, was $532.58 \pm 35.19 \mu\text{m}$ and $527.16 \pm 34.49 \mu\text{m}$, respectively [Table 8]. Tonopachy marginally overestimated CCT compared to ultrasound pachymetry and the difference was statistically significant [$P < 0.001$ for the total and normal population and $P < 0.0001$ for the glaucoma group]. The ICC for CCT by tonopachy and ultrasound pachymetry was 0.94

Table 2: Uncorrected IOP

IOP	Glaucoma (n=213)	Normal (n=213)	Total (n=426)	P [†]
Tonopachy				
Mean (SD)	17.25 (5.13)	12.93 (1.89)	15.09 (4.42)	<0.001
Min-Max	10-35	10-20	10-35	
GAT				
Mean (SD)	18.35 (5.71)	14.92 (2.79)	16.64 (4.80)	<0.001
Min-Max	10-36	10-24	10-36	
P [‡]	<0.001	<0.001	<0.001	-

[†]independent t-test, [‡]Paired t-test

Table 3: Corrected IOP

Corrected IOP	Glaucoma (n=213)	Normal (n=213)	Total (n=426)	P [†]
Tonopachy				
Mean (SD)	17.63 (5.04)	13.40 (2.55)	15.51 (4.52)	<0.001
Min-Max	7.78-39.02	6.42-22.36	6.42-39.02	
GAT				
Mean (SD)	19.42 (5.83)	16.22 (3.13)	17.82 (4.94)	<0.001
Min-Max	10-39	10-24	10-39	
P [‡]	<0.001	<0.001	<0.001	-

[†]independent t-test, [‡]Paired t-test

Table 4: Difference between Tonopachy and GAT corrected IOP (Δ IOP)

Difference between tonopachy and GAT corrected IOP (Δ IOP)	n	%	Mean CCT by tonopachy (SD)	P [^]
<3 mm	275	64.5	532.06 (34.71)	
3-6 mm	100	23.5	534.77 (34.19)	0.397
>6 mm	51	12.0	539.16 (43.25)	
Total	426	100	533.54 (35.70)	

[^]ANOVA

Table 5: Multivariable linear regression analysis to detect factors influencing Δ IOP (GAT-Tonopachy)

Variable	Interval	Multivariable (95% CI)	P
Age	1 year increase	0.024 (-0.003-0.052)	0.087
Baseline GAT IOP	Every 5 mmHg rise	2.08 (1.79-2.38)	<0.001
Glaucoma eyes	vs. Controls	2.59 (1.95-3.23)	<0.001

for the total population and the glaucoma group and 0.93 for the normal group, respectively.

Discussion

In our study, tonopachy consistently reported lower corrected IOP compared to the gold standard, that is, GAT, in eyes with

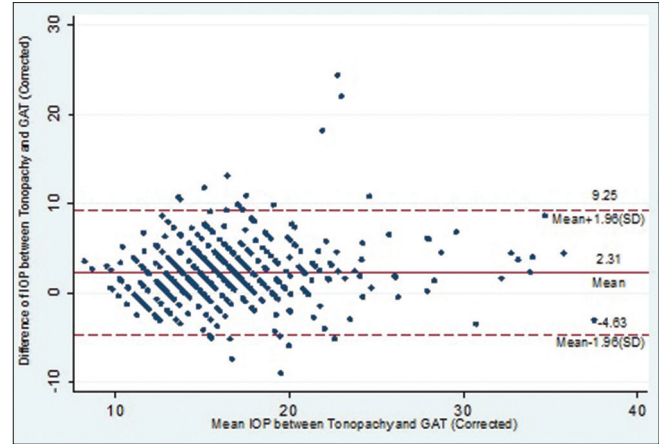


Figure 1: Bland–Altman plot for corrected IOP for total population

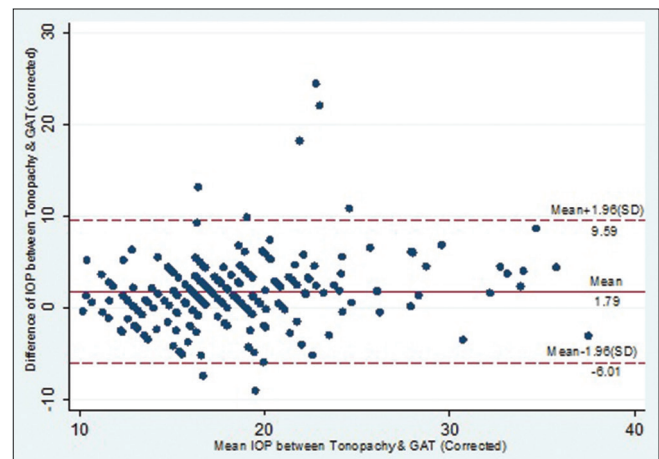


Figure 2: Bland–Altman plot for corrected IOP for glaucoma group

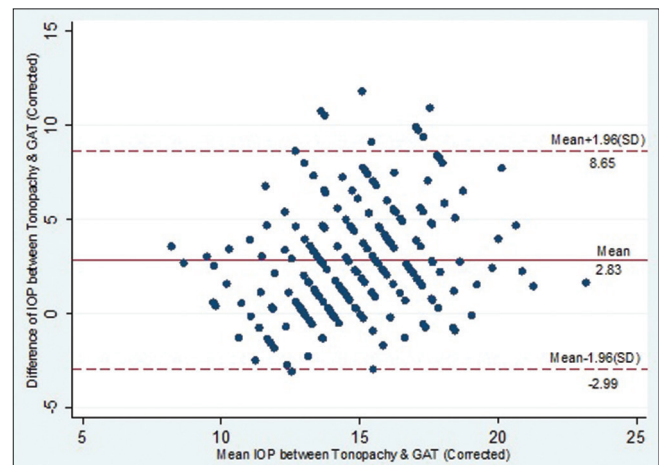


Figure 3: Bland–Altman plot for corrected IOP for controls

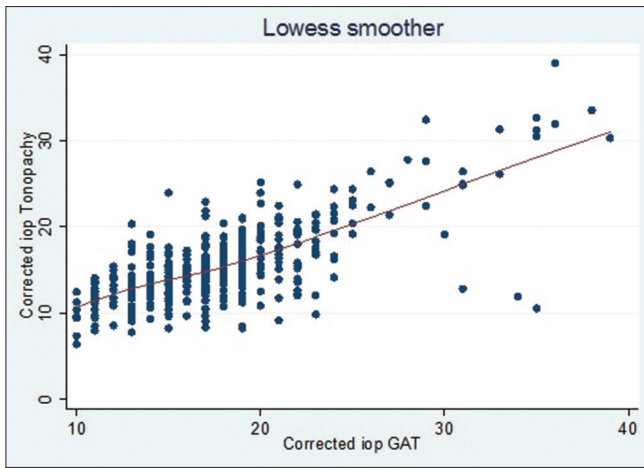


Figure 4: LOWESS curve for corrected IOP by Tonopachy VS GAT for overall patients

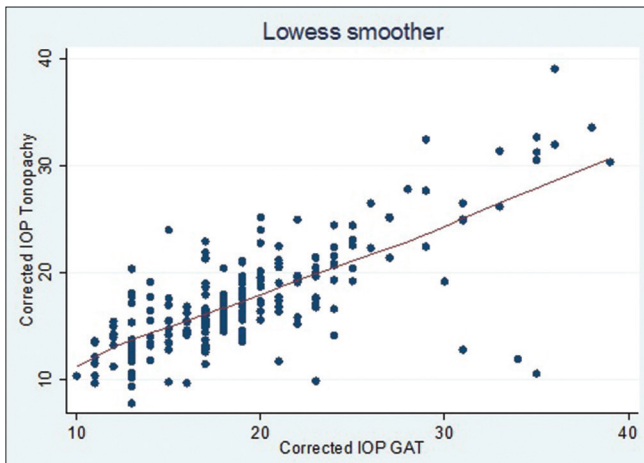


Figure 5: LOWESS curve for corrected IOP by Tonopachy VS GAT in glaucoma patients

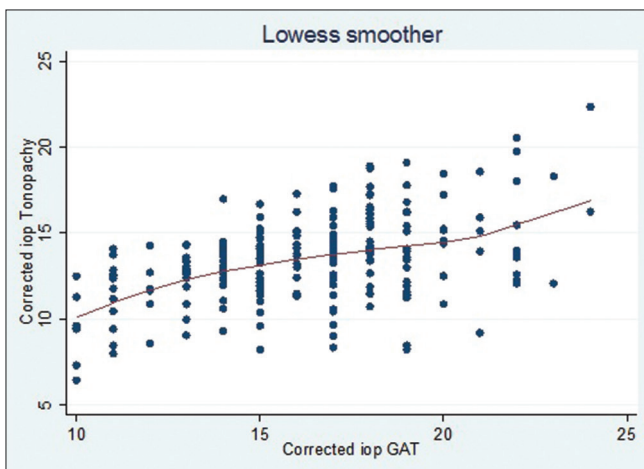


Figure 6: LOWESS curve for corrected IOP by Tonopachy VS GAT in controls

and without glaucoma. The magnitude of underestimation was almost identical at 2 mmHg in both the glaucoma and control groups. Additionally, we found that tonopachy marginally

Table 6: Uncorrected IOP vs. Corrected IOP for Tonopachy

IOP Tonopachy	Glaucoma (n=213)	Normal (n=213)	Total (n=426)	P ^a
Uncorrected				
Mean (SD)	17.25 (5.13)	12.93 (1.89)	15.09 (4.42)	<0.001
Min-Max	10-35	10-20	10-35	
Corrected				
Mean (SD)	17.63 (5.04)	13.40 (2.55)	15.51 (4.52)	<0.001
Min-Max	7.78-39.02	6.42-22.36	6.42-39.02	
P ^b	0.015	0.002	0.0001	-

^aindependent t-test, ^bPaired t-test

Table 7: Uncorrected IOP vs. Corrected IOP for GAT

IOP GAT	Glaucoma (n=213)	Normal (n=213)	Total (n=426)	P ^a
Uncorrected				
Mean (SD)	18.35 (5.71)	14.92 (2.78)	16.64 (4.80)	<0.001
Min-Max	10-36	10-24	10-36	
Corrected				
Mean (SD)	19.42 (5.83)	16.22 (3.13)	17.82 (4.94)	<0.001
Min-Max	10-39	10-24	10-39	
P ^b	<0.001	<0.001	<0.001	-

^aindependent t-test, ^bPaired t-test

overestimated CCT in eyes with and without glaucoma. In contrast to our findings, Lee *et al.*,^[18] Garcia-Resua and Pena-Verdeal *et al.*^[19] and Domenico Schiano *et al.*^[20] found that tonopachy overestimated the IOP compared to GAT. This discrepancy in the observation could be due to the fact that all these studies were performed in healthy eyes with a normal IOP range, and in these studies CCT corrected IOP was not taken into consideration. This could also be due to the overestimation of CCT by tonopachy as in our study.

Tonopachy adapts the IOP measurement method used in NCT. In most studies, comparisons with GAT indicate that the NCT is reliable within the normal IOP range, although the reliability is reduced in the higher pressure ranges.^[17,29-32] Lee *et al.*^[18] observed that differences in IOP measurements between tonopachy and GAT increased with increasing IOP. Even we noticed that higher the baseline IOP, the ΔIOP was high between the two instruments.

It appears from the data that there is a moderate agreement between the corrected IOP provided by the tonopachy and one obtained using GAT and this agreement is less in glaucoma patients compared to controls. Additionally, the agreement seems to be reducing with progressively increasing baseline IOP measurements. Garcia-Resua and Pena-Verdeal *et al.*^[19] and Domenico Schiano *et al.*^[20] reported moderate agreement between the pressure readings provided by the tonopachy and those offered by the GAT. Lee *et al.*^[18] reported good agreement in IOP measurements by tonopachy and GAT. But the limits of agreement between the tonopachy and GAT (95% LoA: -2.3 to 4.7 mm Hg) in his study were slightly larger than those from other studies, which have made similar comparisons between NCT and GAT (95% LoA ranged from - 3.14 to 2.74 mm Hg).^[29]

Garcia-Resua and Pena-Verdeal *et al.*^[19] detected no correlation between CCT and Tonopachy-C IOP

Table 8: Mean CCT by Tonopachy and Ultrasound pachymetry

CCT	Glaucoma (n=213)	Normal (n=213)	Total (n=426)	P ^a
Tonopachy				
Mean (SD)	534.51 (36.26)	532.58 (35.19)	533.54 (35.70)	0.577
Min-Max	437-627	435-633	435-633	
Ultrasound pachymetry				
Mean (SD)	530.09 (34.38)	527.16 (34.49)	528.63 (34.42)	0.380
Min-Max	445-617	444-635	444-635	
P ^b	0.0001	<0.001	<0.001	-

^aIndependent t-test, ^bPaired t-test

(CCT corrected IOP), indicating no significant effect of CCT on tonopachy-C IOP measurements. However, their study involved relatively normal/restricted range of corneal thickness. In our study, both the uncorrected and corrected IOP by tonopachy were consistently lower than the respective uncorrected and corrected IOP by GAT. Also there was a significant difference between the uncorrected and corrected IOP by tonopachy and GAT, indicating that they are not interchangeable.

In our study, the mean IOP difference between tonopachy and GAT was <3 mmHg in 64.5% of the eyes. This finding was somewhat lower than found by others. Rampersad *et al.*^[33] reported that in 79.1% of measurements, the IOP differed by less than 3 mmHg between the tonopachy and GAT. Garcia-Resua and Pena-Verdeal *et al.*^[19] found approximately 88% of the IOP differences between the Goldmann and Tonopachy-NC and 86% of the differences between the Goldmann and Tonopachy-C within 3.0 mmHg. Our results show that the possibility of incurring a clinically significant error when measuring IOP is about one in every third eye examined when using the tonopachy compared with GAT.

Also, regression analysis shows that there is a statistically significant difference between the Δ IOP (difference between the corrected IOP obtained using the Tonopachy and GAT) in control group compared to glaucoma patients, with greater difference in glaucomatous eyes. This suggests that tonopachy may offer less accurate results in glaucomatous eyes than healthy eyes. This is problematic, as greater accuracy is needed in this population. Also, tonopachy underestimates the IOP and its accuracy decreases at higher IOPs which can create issues in glaucoma screening.

Large sample size with a control group, masking the observers to the IOP readings, calculation of CCT corrected as well as uncorrected IOP are the advantages of the study. This study is also unique in that the device is assessed in glaucoma patients at higher ranges of IOP and wider range of CCT. The study is limited by the fact that glaucoma group included predominantly primary glaucomas, secondary glaucomas (except PXFG) were not included. Also present study consisted of south Indian cohort, so the results may not be generalized to the other population. Although the IOP and CCT readings obtained by tonopachy are comparable with that obtained by GAT and ultrasound pachymetry, careful attention should be paid while interpreting the corrected IOP, as the values may not be totally interchangeable. There is statistically significant difference in the efficacy of tonopachy in patients with and without glaucoma.

Conclusion

In conclusion, tonopachy has acceptable agreement compared to GAT, with an advantage of measuring both the IOP and CCT by non-contact method in a single shot without significant expertise. Hence it can be employed as a screening tool for IOP testing in a high volume clinical set up. However, it cannot replace the existing gold standard method for IOP measurement, the GAT.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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