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Comparison of the ICare Rebound Tonometer with Goldmann Applanation Tonometer in refractive errors among patients attending tertiary eye centre in North East India

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ABSTRACT

Objective: To measure intraocular pressure (IOP) in patients with refractive errors and compare variations by means of ICare Rebound Tonometer (RT) and Goldmann Applanation Tonometer (GAT) and to also study the impact of central corneal thickness (CCT) on IOP measurements by these techniques.

Materials and Methods: A total of 182 eyes from 182 subjects were included in this prospective cross sectional study. They were grouped as emmetropia (n=101), hypermetropia (n=11), low myopia (n=43) and high myopia (n=27). Each group underwent IOP measurements first by RT followed by GAT. CCT was assessed by ultrasound pachymetry. Subject preference for the method of IOP measurement was also assessed.

Results: In all four groups, RT detected higher IOP readings than the GAT, significantly more in high myopia (RT-GAT=1.61±2.88mmHg, p=0.002) and low myopia (RT-GAT=1.16±2.72mmHg, p=0.004) as compared to emmetropia (RT-GAT = 0.96±3.27mmHg, p=9.450) and hypermetropia (RT-GAT= 0.23±3.38 mmHg, p=0.398). CCT also showed positive relationship with RT especially in hypermetropia and emmetropia, the overestimation of IOP by 4.63mmHg (p=0.225) and 4.28mmHg (p=0.001) respectively. On the other hand the GAT underestimates IOP in thicker cornea. 52.75% patients preferred GAT as a measuring tool to RT (43.96%).

Conclusions: IOP measurements by RT are overestimated as compared to GAT in both low and high myopia. CCT also has a positive relationship on the IOP measurements by RT. The GAT is therefore still the gold standard for IOP measurement but we cannot rule out the RT as a useful screening tool especially when we want to consider screening patients in peripheral care centres.

1. Introduction

Measurement of Intraocular Pressure (IOP) is one of the basics of ophthalmic examination. Although the Goldmann Applanation Tonometer (GAT) has been described as the' gold standard' for measuring IOP, the accuracy of GAT measurements has been proven to depend on many factors, including corneal thickness, curvature and structure, and axial length.[1,2] There are other limitations of the GAT like requirement of topical anaesthetic, slit lamp biomicroscopy for examination and proper sterilisation before use.

The iCare Rebound Tonometer (Tiolat Oy, Helsinki, Finland) was introduced in 2003 as an alternative to the GAT to measure IOP, the advantage being that it does not require any topical anaesthetic to obtain measurement, uses disposable probes and is easily portable. Studies have shown that the rebound tonometer performs adequately as a screening tool in comparison to the GAT and other handheld

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tonometry devices and is generally accepted to be dependent on corneal parameters like central corneal thickness.[3–6]

From the review of literature available, it is apparent that variations do exist in the measurement of IOP using the two different techniques, viz., GAT and RT. While such studies have been undertaken across patients in different parts of the world by Avitable et al, Kim et al, Cagatay HH et al, Ruiz-Alcocer J et al there have been no instances of such studies being carried out in North East India (NEI).[1,7–9] as such, the present study attempts to bridge the gap in literature by undertaking a study of patients in NEI. Consequently, the main objective of the study is to measure IOP among patients with refractive errors residing in NEI and compare variations, if any, by means of ICare Rebound Tonometer and Goldmann Applanation Tonometer. The impact of CCT on measurement of IOP by these two instruments has also been evaluated.

2. Materials and Methods

For the study, a total of 182 adult patients (18 years and above) have been randomly drawn from the Out Patient Department of Ophthalmology, NEIGRIHMS, Shillong. The study was conducted after clearance from the Institute's Ethics Committee was granted. Informed consent was obtained from all the patients. Patients have been selected based on the following inclusion criteria: Healthy, emmetropic patients as well as those with refractive error. On the other hand, subjects with corneal astigmatism higher than 2D, corneal diseases, contact lens wearers, any ocular inflammation, epithelial edema and those with previous refractive surgery or keratoplasty surgery have not been included in the study.

For the study, only the right eye of each patient was taken into consideration to study the effect of refractive errors on IOP measurement by ICare RT and GAT.

Refractive error has been analysed as spherical equivalent (SE). Accordingly, the patients have been divided into four groups as Group I: emmetropia with -0.5D$<$SE$<$+1.0D; Group II: hypermetropia with SE $\geq$ +1.0D; Group III: low myopia with -3.0D$<$SE $\leq$ -0.5D and Group IV: high myopia with SE $\leq$ -3.0D.

All subjects were required to undergo ophthalmic examination including best corrected visual acuity, slit lamp examination to rule out corneal pathology, previous corneal refractive surgery or keratoplasty surgery. Refraction by autorefractometer (Zeiss Visuref 100) to determine the refractive status was performed under cycloplegia by 3 drops of Tropicamide (1%) in all the subjects.

Intraocular pressure measurement by an experienced and trained technician was first determined by the ICare RT as it does not require any anaesthetic. The tonometer is a light (250g), small, handheld device made up of a probe and a solenoid.10 The disposable probe is 50mm long, 0.3mm in diameter with a 1.7mm diameter plastic end tip and a fixed magnet in the steel casing. In order to take IOP measurements, the device is positioned near the patient's eye, utilizing the forehead as a base support, and the tip of the probe is maintained at a distance of approximately 4-8mm from the cornea. While pressing the measurement button, an electrical pulse is sent to the solenoid and creates a magnetic field, which in turn repels the magnet and the probe. The probe moves, impacts and rebounds from the eye. The movement of the probe and of the fixed magnet induces a voltage in the solenoid, which is amplified and converted into a digital signal by a microprocessor. The voltage created is dependent on the speed of the probe. The software is pre-programmed for six measurements: the highest and the lowest readings are automatically discarded and the average IOP is calculated from the rest of the readings.[10] .

The IOP measurement by ICare RT was then followed by the GAT measurement (Haag Streit Diagnostics AT900) which was performed by an ophthalmologist who was blinded to the IOP recordings by RT. Proparacaine 0.5% (Sunways India Pvt Ltd. Mumbai), a topical anaesthetic was instilled in the eye followed by staining of the eye with wetted fluorescein strip prior to IOP measurement by GAT.

In both cases, three consecutive readings have been taken and the average recorded as the measured IOP in mmHg. After both tests, subjects were asked as to which method of IOP measurement they preferred and their answer was recorded.

An ultrasonic pachymeter (Sonomed Micropach Model 200P+) was used to measure the central corneal thickness (CCT). The procedure adopted is the placement of a sterilized probe on the anaesthetized cornea (by instilling Proparacaine 0.5% drops). A mean of three readings was then calculated for each eye to determine the CCT.

Regression analysis has been used to assess the relationship between CCT with AT and RT (with CCT being the dependent variable) for all categories of patients under the four refractive error groups. All the results have been analysed using MS Excel and SPSS 16.

3. Results

Of the total 182 sampled eyes, 82 represents male and the remaining 100 are female respectively. The age distribution is as presented in Table I with the average age for the sample being 37.7 years for males and 34.5 years for females.

The mean central corneal thickness (microns) and mean IOP readings (mmHg) measured by RT and GAT in different types of refractive errors are presented in Table II.

In all four groups it is seen that the RT detected higher IOP readings than the GAT and the overestimation being more in high myopia (RT-GAT=1.61$\pm$2.88mmHg, p=0.002), low myopia (RT-GAT=1.16$\pm$2.72mmHg, p=0.004) and this is significantly higher than in emmetropia (RT-GAT =0.96$\pm$3.27mmHg, p=9.450) and hypermetropia

Table 1: Age and Sex Description of Sample according to the type of refractive error

Refractive Error type	Female	Male	Total (n)
Emmetropia	56(37.18)	45(39.98)	101
Low Myopia	21(28)	22(33.23)	43
High Myopia	17(27.35)	10(30.6)	27
Hypermetropia	6(57.5)	5(56.4)	11

Notes: Figures in bracket denotes mean age in years

Table 2: Mean Central corneal thickness, Intraocular pressure (mean ±SD) detected by ICare and Goldmann applanation tonometer

Refractive error type	n	Mean CCT (microns)	IOP (RT) mmHg	IOP (GAT) mmHg	RT-GAT mmHg
Emmetropia	101	531.37±32.84	15.34±3.51	14.39±2.95	0.96±3.27
Hypermetropia	11	529.73±31.85	14.91±3.71	14.68±3.19	0.23±3.38
Low myopia	43	533.93±34.79	15.54±2.90	14.38±2.42	1.16±2.72
High myopia	27	528.31±39.28	15.47±2.84	13.85±2.73	1.61±2.88

Table 3: Patients preferred method of examination

Refractive Error	Patients Preference		
	RT	AT	Both
Emmetropia	42	56	3
Low Myopia	23	19	1
High Myopia	11	16	-
Hypermetropia	4	5	2

(RT-GAT= 0.23±3.38mmHg, p=0.398).

However, when taking the CCT into consideration, it has been seen that in thicker cornea the RT highly overestimate the IOP especially in hypermetropia by 4.63mmHg (p=0.225), followed by emmetropia by 4.28mmHg (p=0.001), low myopia by 2.48mmHg (p=0.246) and high myopia by 1.82mmHg (p=0.578). On the other hand, the IOP measured by the GAT is found to be slightly underestimated in thicker cornea by -0.35mmHg in hypermetropia (p=0.935), -0.67mmHg in high myopia (p=0.984), -1.2mmHg in emmetropia (p=0.423) and a slight overestimation in low myopia by 1.3mmHg (p=0.610). Though the findings are not statistically significant this could be due to a small sample size in all types of refractive errors in our study.

When comparing patient preference between the two methods of IOP measurement, all four groups preferred Goldmann applanation tonometry (52.75%) to the ICare Rebound Tonometry (43.96%)

4. Discussion

The ICare rebound tonometer (ICare, Tiolat Oy, Helsinki, Finland) has been introduced as one of the newer instruments to rapidly and accurately measure the IOP, the advantage of this tonometer being lightweight, easy portability and non requirement of topical anaesthetic.[11] Studies have shown that the rebound tonometer performs adequately as a screening tool in comparison to the GAT which is the current gold standard for IOP measurement, and other handheld tonometry devices although it is generally accepted to be dependent on corneal parameters like central corneal thickness[3–6,12] Though some studies have shown that refractive errors influence the IOP readings other studies have shown to disagree.[1,7,9,13]

To our knowledge this is the first study carried out in a tertiary eye care centre in North East India to study variations in IOP measurements using Goldmann Applanation Tonometer and ICare Rebound Tonometer in patients with refractive errors. The impact of CCT on measurement of IOP by these two instruments has also been evaluated.

Nomura H et al found a significant relationship between IOP and refractive error (positive association between IOP and increasing degrees of myopia).[13] Avitable T et al also found a significant correlation between the refraction and the RT-GAT difference in myopic eyes (linear regression $p<0.001$).[1] However, Ruiz- Alcocer A. et al and Kim KN et al in their studies have found that there was no correlation between refractive error and IOP.7,9 Cagatay HH et also found a good level of agreement between RT and GAT in high myopic patients.[8]

The results in our study show that higher IOP values were detected by RT in high myopic (p=0.002) and low myopic (p=0.004) eyes as compared to emmetropia and hypermetropia, which is similar to findings reported by Avitable et al and Nomura et al.

When considering the effect of CCT on IOP measurements by RT and GAT, our study show overestimation

of IOP by RT as compared to GAT in thicker cornea especially in hypermetropia (p=0.225) and emmetropia (p=0.001). Although the overestimation in hypermetropia is not statistically significant, this could be because of a small sample size. The results demonstrate that there is a higher degree of positive relationship between CCT and RT and GAT IOP measurements as we move from high myopia patients to hypermetropia patients. This overestimation by RT is also similarly seen in other studies by Brusini et al, Martinez-de-la-Casa et al, Pootschi et al, Pakrou et al, whereas this has not been reported by others. [1,5,7,10,12,14–16]

Interestingly, in our study we found that most participants prefer the GAT to the RT for measurement of IOP which is in contrary to reports by Pakrou et al where they reported RT to be more comfortable. [14]

However, one of the few limitations of our study is small sample size of refractive errors. It may be noted here that the study concentrates itself only on the comparison of RT and GAT in measurement of IOP with different refractive errors and there may be other possible factors influencing the variations in these measures which is beyond the scope of the present study.

5. Conclusion

IOP readings by ICare RT are overestimated in myopia. The RT showed more positive relationship with CCT on IOP measurement than GAT. Therefore, in hypermetropia and emmetropia the CCT may be more likely to result in greater errors when using RT. GAT is therefore still the gold standard for IOP measurement. However, the study does not rule out ICare RT as a useful alternative screening tool in peripheral care centres. The advantage being easy portability, non-requirement of topical anaesthetic and use of disposable probes which obviates the need to sterilise before each use and reduces the chances of cross infection.

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7. Conflict of Interest

None.

8. Financial Disclosures

None.

References

1. Avitable T, Longo A, Rocca D, Amato R, Gagliano C. The influence of refractive errors on IOP measurement by rebound tonometry (ICare) and Goldmann applanation tonometry. *Graefes Arh Clin Exp Ophthalmol*. 2010;248(4):585–591.
2. Whitacre MM, Stein R. Sources of error with use of Goldmann-type tonometers. *Surv Ophthalmol*. 1993;38:1–30.
3. Fernandes P, Diaz-Rey JA, Queiros A, Gonzalez-Meijome JM. Comparison of the iCare rebound tonometer with the Goldmann tonometer in a normal population. *Ophthalmic Physiological Optics*. 2005;25(5):436–440.
4. Abraham LM, Epasinghe N, Selva D, Casson R. Comparison of the iCare rebound tonometer with the Goldmann applanation tonometer by experienced and inexperienced tonometrists. *Eye*. 2008;22(4):503–506.
5. Martinez-De-La-Casa JM, Jimenez-Santos M, Saenz-Frances F. Performance of the rebound, noncontact and Goldmann applanation tonometers in routine clinical practice. *Acta Ophthalmol*. 2011;89(7):676–680.
6. C Pasaoglu I A, Olcucu O, Alagoz N, Satana B. Comparison of Goldmann Applanation Tonometry and ICare Rebound Tonometry in Eyes of Varied Corneal Thickness. *Beyoglu Eye J*. 2017;1:9–12.
7. Kim NK, Jeoung JW, Park KH, Yang MK, Kim DM. Comparison of the new rebound tonometer with Goldmann applanation tonometer in a clinical setting. *Acta Ophthalmol*. 2013;89:392–396.
8. Cagatay HH, Ekinci M, Yazar Z, Gokce G, Ceylan E. Comparison of ICare Rebound Tonometer and Goldmann Applanation Tonometer in High Myopia. *Sci World J*. 2014;.
9. Ruiz-Alcocer J, Madrid-Costa D, Prez-Vives C, Garca-Lzaro S, JJ. Rebound tonometery for the measurement of intraocular pressure and its relation with gender and refractive errors in Mozambique. *Ther*. 2011;8(5):555–561.
10. Brusini P, Salvetat ML, Zeppieri M, Tosoni C, Parisi L. Comparison of I-Care Tonometer with Goldmann Applanation Tonometer in Glaucoma Patients. *J Glaucoma*. 2006;15(3):213–217.
11. Kontiola AI. A new induction-based impact method for measuring intraocular pressure. *Acta Ophthalmol Scand*. 2000;78:142–145.
12. Poostchi A, Mitchell R, Nicholas S, Purdie G, Wells A. The iCare rebound tonometer: comparisons with Goldmann tonometry, and influence of central corneal thickness. *Clin Exp Ophthalmol*. 2009;37:687–691.
13. Nomura H, Ando F, Niino N, Shimokata H, Miyake Y. The relationship between intraocular pressure and refractive error adjusting for age and central corneal thickness. *Ophthal Physiol Opt*. 2004;24:41–45.
14. Pakrou N, Gray T, Mills R, Landers J, Craig J. Clinical Comparison of the Icare Tonometer and Goldmann Applanation Tonometry. *J Glaucoma*. 2008;17:43–47.
15. Chui WS, Lam A, Chen D, Chiu R. The influence of corneal properties on rebound tonometry. *Ophthalmol*. 2008;115:80–84.
16. Iliev ME, Goldblum D, Katsoulis K, Amstutz C, Frueh B. Comparison of rebound tonometry with Goldmann applanation tonometry and correlation with central corneal thickness. *Br J Ophthamol*. 2006;90:833–835.

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