www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v6i9.126

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

To study the role of Non-contact Tonometry for measurement of intraocular pressure in patients attending ophthalmology outpatient department

Authors
Dr Sakshi Sahni, Dr Nalini Birpuri
Department of Ophthalmology, GMC Jammu, India

Introduction

The intraocular pressure is the fluid pressure inside the eye. It is the result of a dynamic balance between aqueous humour formation and outflow, which are nearly equal under normal conditions. Normal intraocular pressure varies between 10.5 to 20.5 mmHg with a mean pressure of 15.5 ±2.57mmhg (leydecker 1958). Intraocular pressure has an important role in case of detection of glaucoma, one of the most important cause of blindness worldwide. Ocular hypertension is associated with an increased risk of developing glaucoma and reducing intraocular pressure has shown to lessen progressive loss of visual field.

Accurate and precise measurement of intraocular pressure is, therefore, fundamental to the management of glaucoma. Three types of tonometer are used clinically viz. Indentation, Applanation and Non Contact Tonometer. Schiotz, in 1905 developed prototype of indentation tonometer. The concept of applanation tonometry is based on Imbert Ficks law which states that pressure inside a sphere (P) is equal to the force (F) required to flatten its surface divided by the area of flattening (A) . P=W/A.

Goldmann in 1954 modernised this tonometer and currently it is the most popular and accurate tonometer. This device is mounted on a slit lamp bio microscope. The standard Goldmann tonometer falls somewhat short in the regard due to its requirement for a slit lamp (non portability), topical anaesthesia, fluorescein and an ophthalmologist.

Bernard Grolman (1950) invented Non Contact Tonometer based on principle of applanation tonometer. Routine screening for glaucoma began with NCT.

Advantages of NCT: It doesnot require mechanical contact with the eyes, anaesthesia or eyelid retraction. It virtually eliminates professional skill and judgement as a factor influencing accuracy and reliability. NCT has the advantage that it reduces the possible risk of cross infection. Interpretation of result are easier than with GAT. NCT is a very fast, simple and rapid method for mass screening.

Material and Methods

This proposed study was conducted on 150 patients attending outpatient department for ocular examination at Upgraded Department Of Ophthalmology, Govt Medical College, Jammu and the cases were selected at random and enrolled in the study. Patients with age >20 years are included in the study.

Patients with BSCVA <3/60 and patients with history of severe dry eye syndrome, drug allergy (fluorescein, proparacaine), corneal abnormalities (corneal edema and scarring), ocular inflammation and infection, ocular trauma and recent ocular surgery(<3 months) were excluded from the study. Complete ocular examination including unaided visual acuity and the best corrected visual acuity with refraction was recorded. Anterior segment examination was done with slit lamp. Posterior vitreous, disc and macular examination were done by slit lamp biomicroscopy with 90D lens. The IOP measurement was taken with the subjects relaxed in seated position with both the eyes open. The mean of three consecutive readings per device were used for statistical analysis. The intraocular pressure assessment with the Goldmann applanation tonometer was subsequent to that with the non contact tonometer (CT-80) to prevent bias due to reduction of measured intraocular pressure caused by indentation or applanation.

The IOP was first measured with a non contact tonometer .The compressed air knob was cleaned before each measurement. Patient position was adjusted and the eyepiece reticule ring was brought to good focus and then three readings were taken with NCT (CT-80) in automode and average of three readings was taken to get the final result for each eye.

After taking NCT measurements, applanation tonometry was performed with a gap of atleast 15 minutes. The probe of Goldmann applanation tonometer was cleansed with 70% isopropyl alcohol and dried. Maximum illumination with cobalt blue filter and 16 times magnification was adjusted in the slit lamp. The tonometer was set to the zero mark prior to the start of examination. The cornea was anaesthetised with 0.5% proparacaine eye drops. The tear film was stained with 1% sodium fluorescein strip. The tip of the probe was advanced to approximate the cornea. The biprism splits the circle of contact into two semi circle mires. Adjustments were made to oppose the mires. Final readings were calculated by multiplying the reading on the knob by 10 to get the final IOP in mm of Hg. Three readings were averaged to get IOP for each eye. Antibiotic eyedrops were instilled in patients eye after the procedure was completed.

Statistical Analysis

The data was analysed using statistical software MS EXCEL and SPSS version 17.00 for windows. Main outcome variable was expressed as mean and standard deviation and its relationship was evaluated using correlation coefficient. Linear regression analysis was also performed to find prediction equation for IOP. A p value<0.05 was considered as statistically significant.

Results

The IOP measurements were taken with both types of tonometer on each patient. The difference of the means of NCT and GAT were taken and the results were compared in terms of accuracy. Following are the observations of our study:

Table no. 1: Showing mean IOP and GAT in right eye of patients in different age groups.

AGE(YEARS)	NCT(RE)	GAT(RE)
20-30	16.21	15.57
31-40	16.42	15.93
41-50	16.51	15.93
51-60	16.64	15.88
>60	13.5	14

In our study, the NCT readings were higher than the GAT readings in all age groups.

Table no.2: Showing mean IOP with NCT and GAT in left eye of patients in different age groups

AGE(YEARS)	NCT(LE)	GAT(LE)
20-30	16.39	15.6
31-40	16.34	15.68
41-50	16.51	15.95
51-60	17.28	16.88
>60	13.5	13

In our study, the NCT readings were higher than the GAT readings in all age groups.

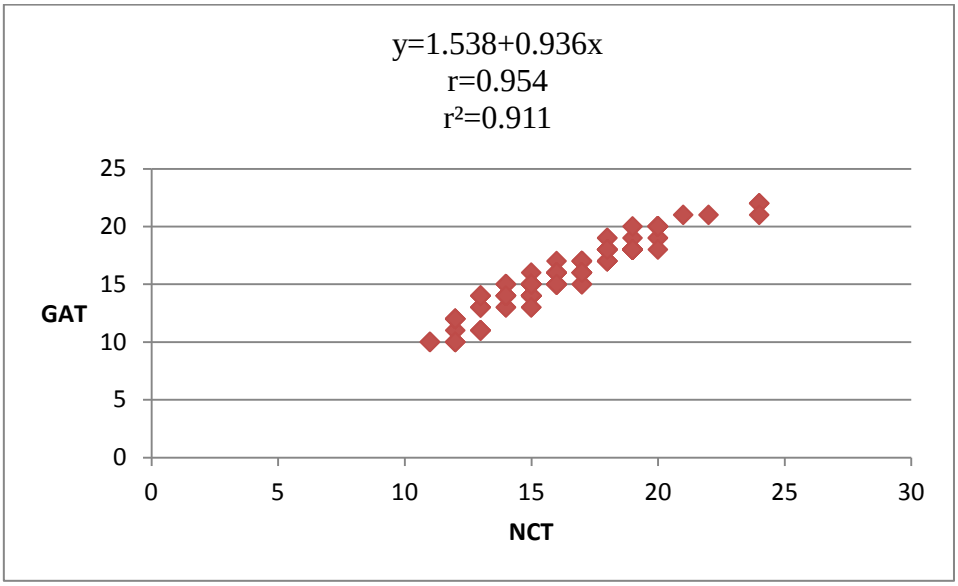
Table no.3: Showing mean IOP with NCT and GAT in right and left eye of 150 patients

EYE	NCT(mm of Hg)	GAT(mm of Hg)
right	16.72	16.33
left	16.78	16.37

In our study, mean IOP with NCT in right eyes of 150 patients was 16.72±1.94 mm of Hg and mean IOP with NCT in left eyes was 16.78±1.99mm of Hg.

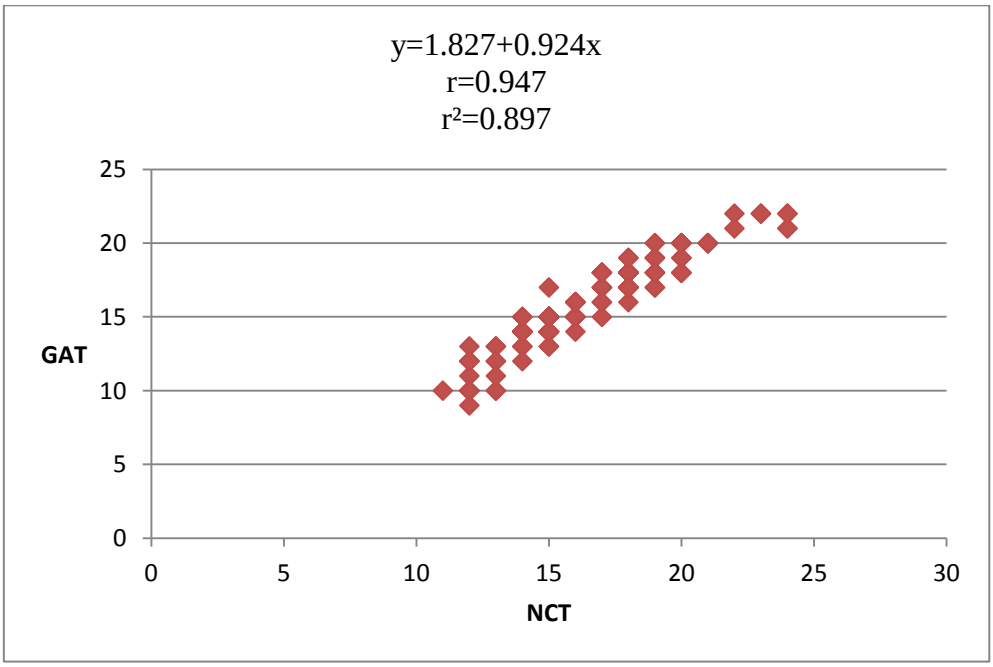
Mean IOP with GAT in left eyes of 150 patients was 16.33±1.94mm Hg and mean IOP with GAT in left eyes was 16.37±1.99mm Hg.

Fig .1: Scatter plot showing correlation between the IOP measured with NCT and GAT in right eye of 150 patients.



The scatter plot showing a high positive linear relationship between IOP measurement obtained with NCT and GAT with a correlation coefficient of 0.954(t=38.00, p<0.0001)

Fig . 2 : Scatter plot showing correlation between the IOP measured with NCT and GAT in left eye of 150 patients.



Scatter plot showing a high positive relationship between IOP measurements obtained with NCT and GAT with a correlation coefficient of 0.947. (t=35.937, p<0.0001)

Table No. – 4: Showing total number of patients in different IOP range (right eye)

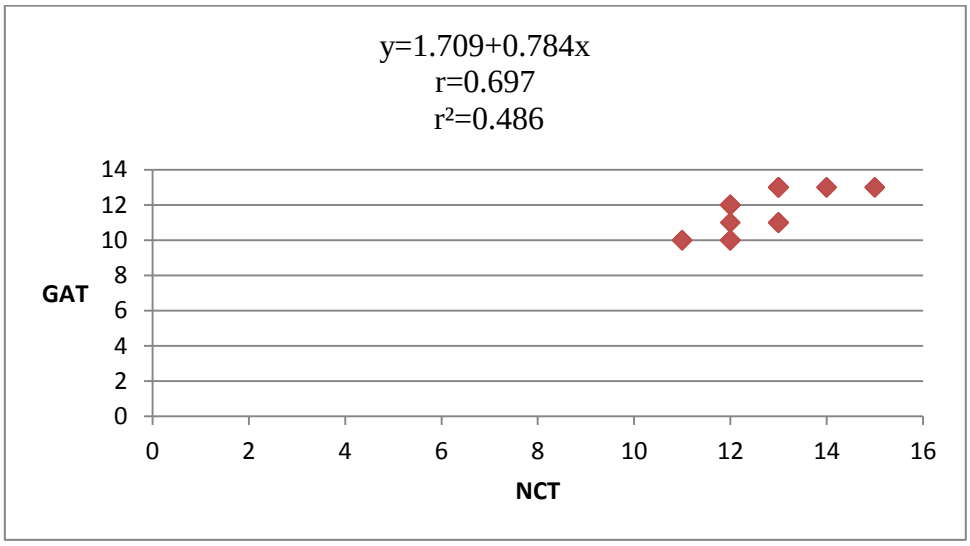
		No. of patients	
S.No	IOP(mm Hg)	GAT	NCT
1	<14	22	18
2	14-20	123	119
3	>20	5	5

The proportion of eyes with GAT measurement of IOP <14mm Hg detected by NCT was 18/22 (81.8%).

The proportion of eyes with GAT measurement of IOP between 14-20mmHg detected by NCT was 119/123 (96.7%).

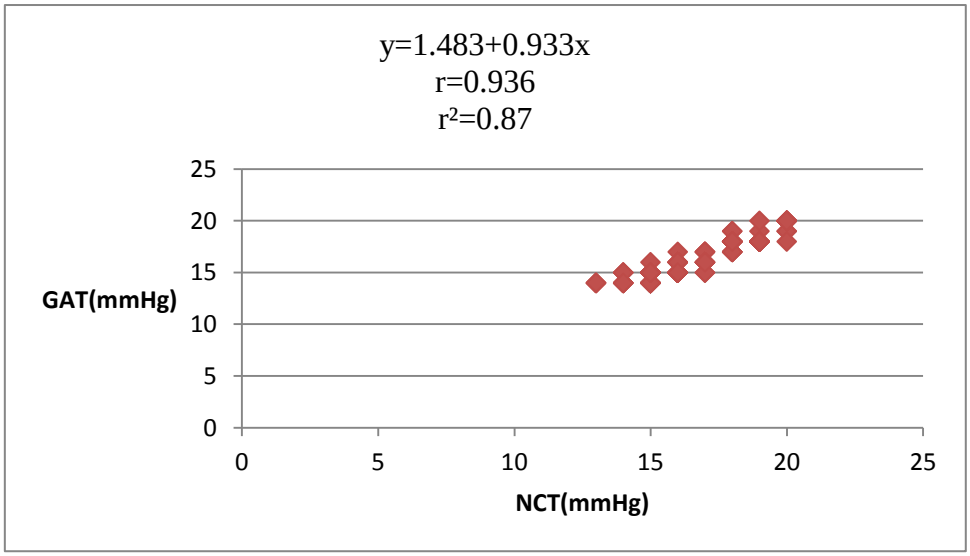
The proportion of eyes with GAT measurement of IOP more than 20mmHg detected by NCT was 5/5 (100%).

Fig. 3: Scatter plot showing correlation between non-contact and Goldmann applanation tonometer in eyes (right) with IOP <14mmHg.



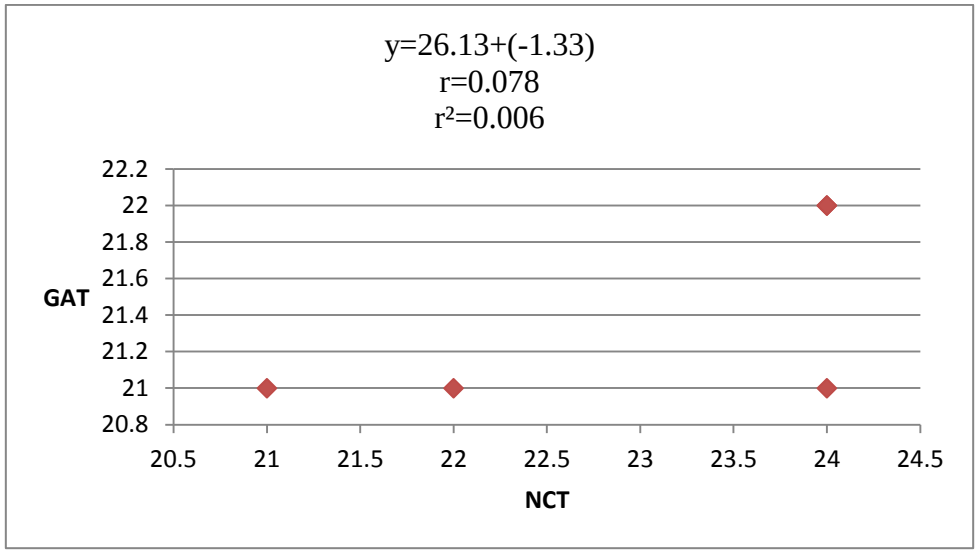
Scatter plot showing weak relationship between NCT and GAT in the IOP<14mmHg with a correlation coefficient of 0.697. (t=4.350, p=0.466)

Fig. 4 : Scatter plot correlation between non-contact and Goldmann applanation tonometer in eyes (right) with IOP between14-20 mmHg



Scatter plot showing positive relationship between IOP measurements obtained with NCT and GAT in the range 14-20mm Hg with a correlation coefficient of 0.936.(t=29.21 , p=0.006)

Fig. 5: Scatter plot showing correlation between non-contact tonometer and Goldmann applanation tonometer in eyes (right) with IOP >20mmHg



Scatter plot showing no relationship between IOP readings >20mmHg obtained with NCT and GAT with a correlation coefficient of 0.078. (t= -0.191, p=0.134)

Table No.5: Showing total number of patients in different IOP range (left eye) with NCT and Goldmann applanation tonometry.

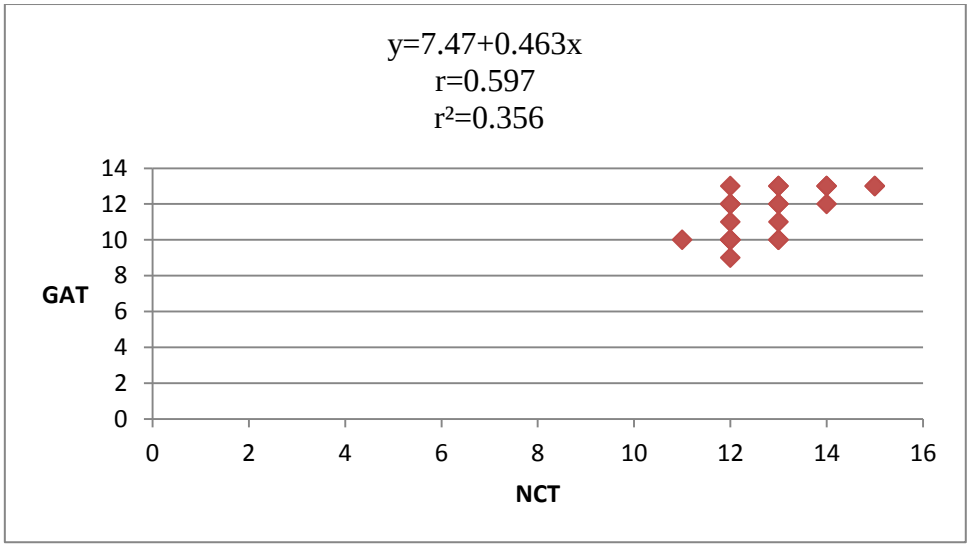
		No. of patients	
S.no	**IOP(mm Hg)**	**GAT**	**NCT**
1	<14	23	18
2	14-20	119	115
3	>20	8	8

The proportion of eyes with Goldmann Applanation Tonometry measurement of IOP <14mm Hg detected by NCT was 18/23(78%).

The proportion of eyes with Goldmann Applanation Tonometry measurement of IOP between 14 -20mmHg detected by NCT was 115/119(96.63%).

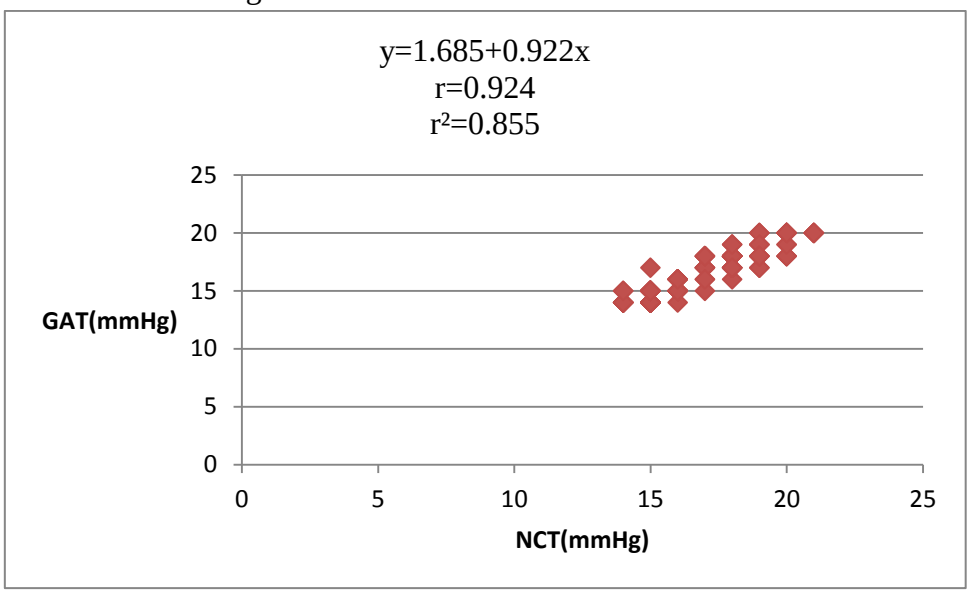
The proportion of eyes with Goldmann Applanation Tonometry measurement of IOP >20 mmHg detected by NCT was 8/8 (100%).

Fig. 6 : Scatter plot showing correlation between non-contact and Goldmann applanation tonometer in eyes (left) with IOP <14mmHg



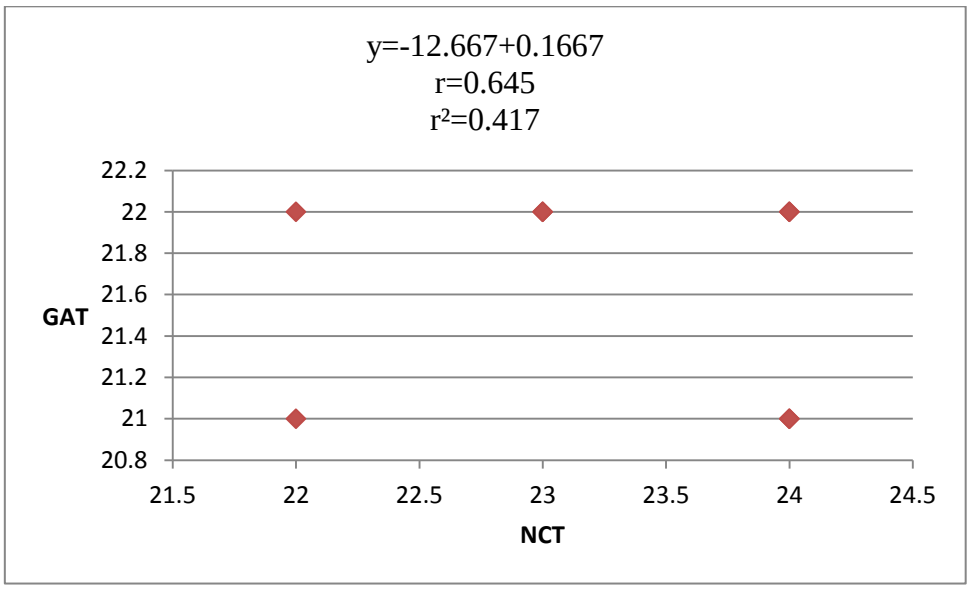
Scatter plot showing weak relationship between NCT and GAT in the IOP <14mm Hg with a correlation coefficient of 0.597 (t= 3.407, p=0.0001).

Fig.7- Scatter plot showing correlation between non-contact and Goldmann applanation tonometer in eyes (left) with IOP between14-20 mmHg.



Scatter plot showing positive relationship between IOP readings obtained with NCT and GAT in the range between 14-20mmHg with a correlation coefficient of 0.924. (t=26.230, p=0.004)

Fig. 8: Scatter plot showing correlation between non-contact tonometer and Goldmann applanation tonometer in eyes (left) with IOP >20mmHg.



Scatter plot showing weak relationship in the IOP >20mmHg between NCT and GAT with a correlation coefficient of 0.645. (t= 1.46, p=0.239)

Discussion

Elevated IOP is generally accepted as one of the most important risk factor for development of glaucoma. It is also known as the only modifiable risk factor for development of glaucoma. There are many tonometers available but Goldmann applanation tonometer is still considered the most accurate and dependable method for measurement of IOP. However the utility of NCT can't be overemphasized in bigger hospitals catering to a large number of patients. Our study aimed to see the reliability of NCT for measurement of IOP as a screening tool and studied its correlation with the standard applanation tonometry.

For the purpose of statistical analysis we divided IOP readings in three subgroups taking GAT as

standard, to determine whether IOP level had any influence on the results.

Group 1 : IOP <14mmHg
Group 2 : IOP 14-20mmHg
Group 3 : IOP>20 mmHg

Majority of the eyes were found to be in the less than 20mmHg group. i.e. 96.6% eyes in the GAT group in the right eye and 94.6% eyes in left eyes.

Choi WJ et al (1990)in his study of reliability of NCT as a method of mass screening had majority of patients in IOP range of less than 21mm Hg.i.e.86.1% in GAT group and 88% in the NCT group. In our study mean IOP with NCT in right eye of 150 patients was 16.34±2.61mmHg and mean IOP with NCT in left eyes was 16.52±2.82mm Hg .Mean IOP with GAT in right was 15.82±2.66mmHg and mean IOP with GAT in left eyes was 15.90±2.89mmHg. the mean difference in IOP readings between two types of tonometry was 0.52±0.80 mmHg(RE) and 0.61±0.93mmHg(LE) with the NCT readings returning higher than the GAT. The correlation coefficient (r) between the NCT and GAT in right and left eyes of 150 patients were 0.954 and 0.947 respectively and it is statistically significant (p<0.0001).

In the first group ,the mean IOP difference was 1.04±0.89mmHg and 1.30±1.10mmHg for right and left eyes respectively and the correlation coefficient(r) was 0.697(p<0.466) and 0.597 (0.0001) for right and left eyes respectively. In the second group, the mean difference in IOP was 0.39±0.69mmHg and 0.41±0.77mmHg for right and left eyes respectively and correlation coefficient (r) between NCT and GAT in right and left eyes were 0.936(p<0.006) and 0.924(0.004) respectively in the third group, the mean difference was 1.60±1.44mmHg and 1.62±1.06 mmHg for right and left eyes respectively and the correlation coefficient (r) was 0.078(p=1.134) and 0.645(p=0.239) for right and left eyes respectively. Tonnu PA **(**2005) in his study of comparison of four methods of tonometry demonstrated tht NCT had a tendency to overestimate the GAT at high IOP and underestimate the GAT at high IOP and underestimate the GAT at low IOP. Ogbuehi KC et al (2006), in a study of assessment of accuracy and reliability of Topcon CT 80 NCT with those of GAT on 60 right eyes of young healthy subjects with normal IOP found no statistically significant difference between the average IOP measured with the two techniques (p>0.05).the Topcon CT 80 NCT proved to be accurate and as reliable as the GAT in the assessment of IOP. Salim S (2009) in a study compared the measurements by the portable NCT PT100 with the GAT. The IOP measurements showed no significant difference in the measurements performed by the two tonometers (p=0.64). The findings of our study corroborates with the above mentioned studies.

Conclusion

NCT gives comparable results in normal pressure range (<20mmHg) with the NCT readings slightly higher than GAT. So NCT can be used as a screening procedure in tertiary care centres catering to a large no of patients wherein it is not possible to do GAT on all patients.

References

1. Schiotz HA. The Intraocular pressure In: Duke Elder S(ed). System of Ophthalmology, The Physiology of the Eye and of the Vision.1968. Henry Kimpton, London. Vol IV. pp.233-34.
2. Forbes M, Pico, Grolman B. A non-contact tonometer. Description and clinical evaluation. Archive of ophthalmology 1974; 91:134-40.
3. Choi WJ, Kim JW, Tchah H, Jin YH, Kim YJ. Non-Contact tonometry; an ideal method for mass screening. Korean J Ophthalmol 1990; 4 : 30-33.
4. Tonnu PA, Ho T, Sharma K,White E, Bunce C ,Heath DG. A comparison of four methods of tonometry: method agreement and interobserver variability. Br J Ophthalmol 2005; 89 : 847-50.

5. Ogbuehi KC. Assessment of the accuracy and reliability of the Topcon CT80 non-contact tonometer. Clin Exp Optom 2006; 89 : 310-14.
6. Salim S, Linn DJ, Echols2 JR, Netland PA. Comparison of intraocular pressure measurement with the portable PT100 non-contact tonometry with the Goldmann applanation tonometery. Clinical Ophthalmology 2009; 3 : 341-44.
7. Rao BS. Clinical evaluation of the non-contact tonometer and comparison with Goldmann applanation tonometer. Indian J Ophthalmology1984; 32 : 432-34.
8. AlMubrad TM. Performance of the PT100 Non-contact tonometer in healthy eyes. Clinical Ophthalmology 2011; 5:661-66.
9. Augsburger A, Terry JE. Non-contact and Mackay-Marg tonometry:comparison in patients ages 7 to 85 years. Am J Optom Physiol Opt 1977; 54:31-34.
10. Fick. Examination of the Eye In: Duke Elder S(ed) System of Ophthalmology, The Foundations of Ophthalmology : 1968 Henry Kimpton, London. Vol VII.pp.348-49.
11. Goldmann. Examination of the Eye In: Duke Elder S(ed). System of Ophthalmology, The Foundations of Ophthalmology. 1968. Henry Kimpton, London. Vol VII.pp.348-49.
12. Hansen MK. Clinical comparison of the XPERT Non contact tonometer and conventional Goldmann applanation tonometer. Acta Ophthalmol Scand 1995; 73 : 176-80.
13. Popovich KS, Shields MB. A comparison of IOP measurements with the XPERT NCT and GAT. J Glaucoma 1997; 6: 44-46.
14. Stamper, Robert L. A history of intraocular pressure and its measurement. Optometry and Vision Science 2011; 88E 16-28.
15. Shields MB. The non contact tonometer: Its value and limitations. Surv ophthalmol 1980; 23 : 211.
16. Wittenberg S. A clinical evaluation of the non-contact tonometer. J Am Optom Assoc 1977; 48 : 196-206.