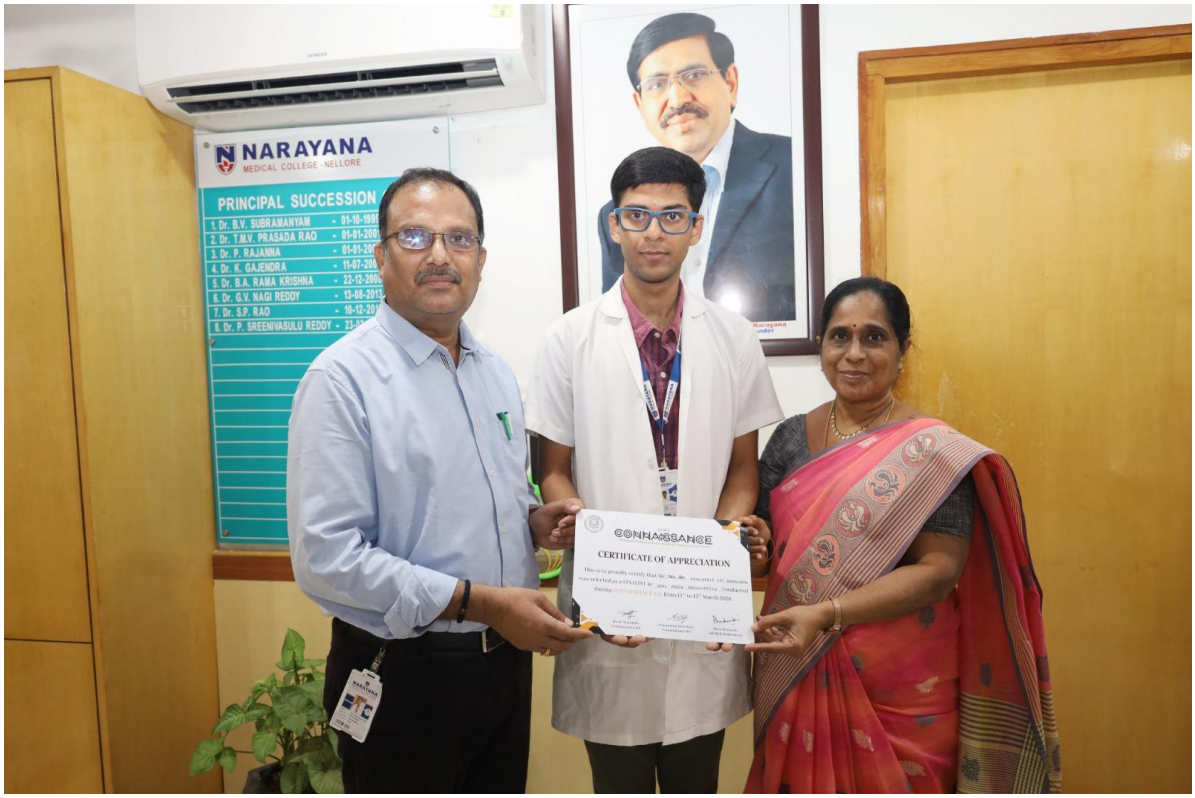
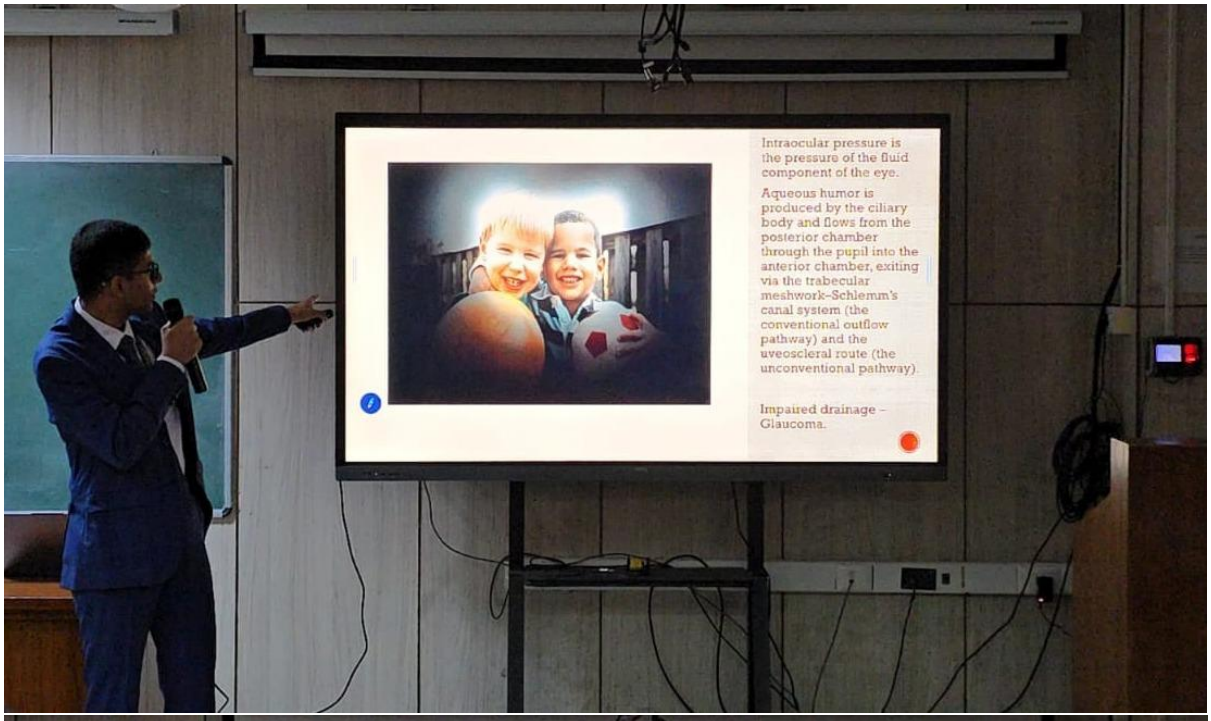
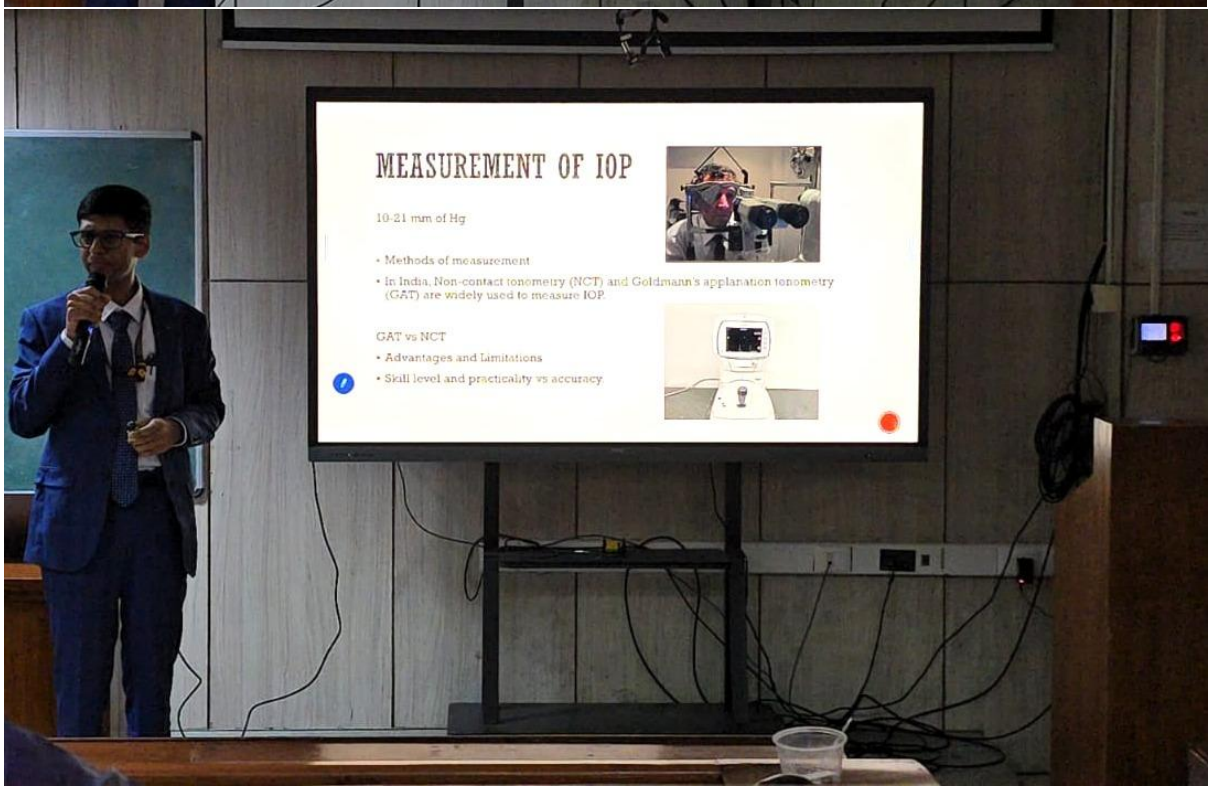
NARAYANA MEDICAL COLLEGE

CHINTHAREDDYPALEM, NELLORE

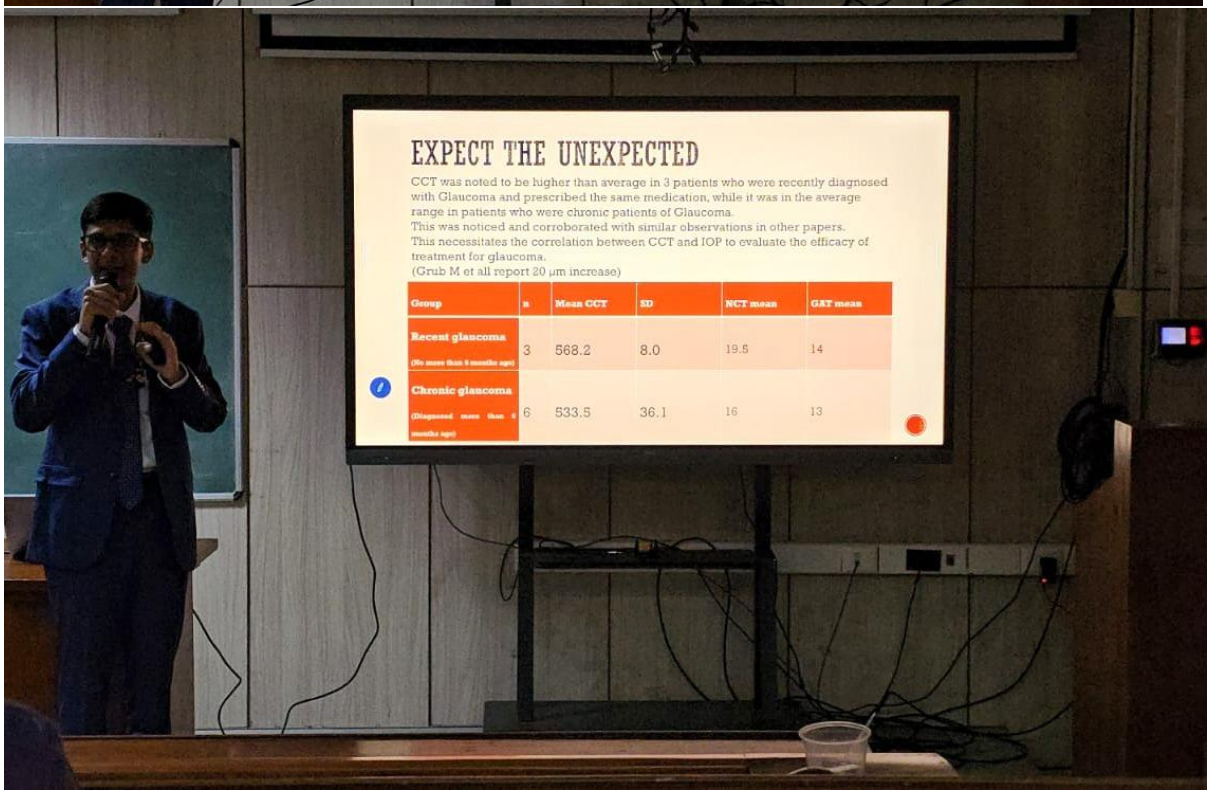
Mr.Velicharla Sai Sankeerth, 2nd MBBS student from Narayana Medical College was selected for oral paper presentation titled, **"Difference in values of Intra-Ocular pressure between Goldmann Applanation Tonometry and Non-Contact tonometry - A Comparative Study"** and presented the same at the Undergraduate research conference Connaissance 8.0 held at JIPMER Pondicherry from **13.03.2026 to 15.03.2026** under the guidance of **Dr. V Vijayalakshmi**, Prof. & HOD of Ophthalmology department.




Intraocular pressure is the pressure of the fluid component of the eye.
Aqueous humor is produced by the ciliary body and flows from the posterior chamber through the pupil into the anterior chamber, exiting via the trabecular meshwork–Schlemm's canal system (the conventional outflow pathway) and the uveoscleral route (the unconventional pathway).
Impaired drainage – Glaucoma.


MEASUREMENT OF IOP
10-21 mm of Hg
• Methods of measurement
• In India, Non-contact tonometry (NCT) and Goldmann's applanation tonometry (GAT) are widely used to measure IOP.
GAT vs NCT
• Advantages and Limitations
• Skill level and practicality vs accuracy


In this study, a total of 19 eyes showed a difference of more than 5 mmHg between NCT and GAT. The mean difference was +8.75-+9.0 and the mean CCT was 600 µm in both the cases.
This shows that a very large increase in corneal thickness from the mean value of ~543 µm shows an increased positive deviation between GAT and NCT.
Eye
n (eyes)
NCT–GAT difference
Mean CCT
OD
11
+9.0
600.4
OS
8
+8.75
599.8

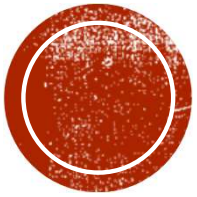

EXPECT THE UNEXPECTED
CCT was noted to be higher than average in 3 patients who were recently diagnosed with Glaucoma and prescribed the same medication, while it was in the average range in patients who were chronic patients of Glaucoma.
This was noticed and corroborated with similar observations in other papers.
This necessitates the correlation between CCT and IOP to evaluate the efficacy of treatment for glaucoma.
(Grub M et all report 20 µm increase)
Group
n
Mean CCT
SD
NCT mean
GAT mean
Recent glaucoma
3
568.2
8.0
19.5
14
Chronic glaucoma
6
533.5
36.1
16
13

DIFFERENCE IN VALUES OF INTRA-OCULAR PRESSURE BETWEEN GOLDMANN APPLANATION TONOMETRY AND NON-CONTACT TONOMETRY – A COMPARATIVE STUDY

Velicharla Sai Sankeerth

2nd MBBS Student

Slot number – 15



INTRODUCTION

WHAT IS IOP?

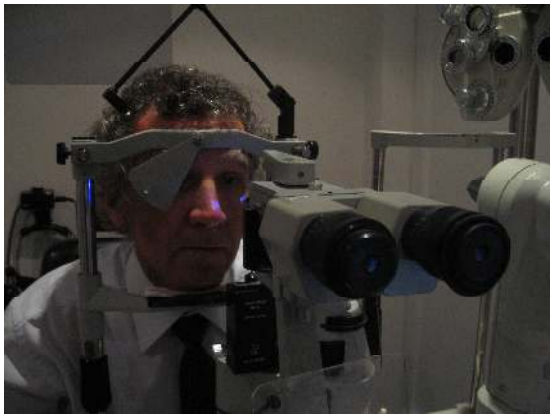
What makes it one of the leading causes of irreversible blindness?

Intraocular pressure is the pressure of the fluid component of the eye.

Aqueous humor is produced by the ciliary body and flows from the posterior chamber through the pupil into the anterior chamber, exiting via the trabecular meshwork–Schlemm's canal system (the conventional outflow pathway) and the uveoscleral route (the unconventional pathway).

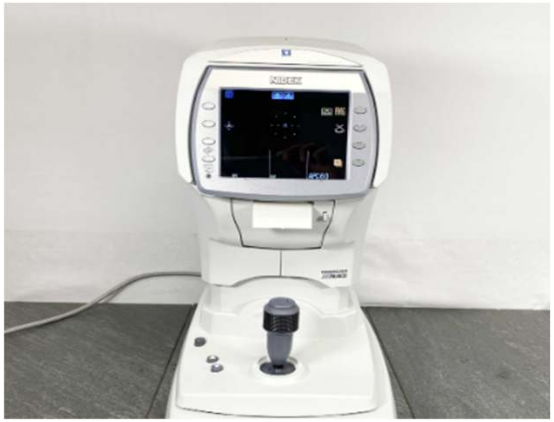
Impaired drainage – Glaucoma.

MEASUREMENT OF IOP



10-21 mm of Hg

- Methods of measurement
- In India, Non-contact tonometry (NCT) and Goldmann's applanation tonometry (GAT) are widely used to measure IOP.



GAT vs NCT

- Advantages and Limitations
- Skill level and practicality vs accuracy.

WHAT DID I EXPECT

The **aim** of this study is to find any difference and the magnitude of the difference in the values of intra-ocular pressures when measured by two different methods; non-contact tonometry and Goldmann applanation tonometry.

Objectives

- To find an association with the deviation of IOP values and the value of central corneal thickness.
- To identify any pattern in the deviation of IOP values between both the methods based on the ocular pathology.
- To correlate the deviation in IOP with the age of the subject.

HOW DID I WANT TO DO IT?

- **Study design:** An analytical **cross-sectional comparative study** was be done. The data was taken at the instant of examination and no follow up or a prospective/retrospective design was chosen as per the requirements of this study.
- **Study period:** 3 months was the duration of the study
- **Sample size:** 75 patients as sample size, i.e. 150 eyes.
- This study was performed in the study center with the instruments available in the **Ophthalmology department** of the institution.
- Post consent, the Intra-ocular pressure values will be recorded as per institution protocols; the subject's IOP will be measured by both non-contact tonometry and Goldmann applanation tonometry (NCT and GAT) and the values will be recorded. Central corneal thickness will be measured and correlated with the IOP values
- Sterilisation is primary **quality control** in clinical studies.
- **Ethical guidelines** of the institution were followed and it was informed that no personal data of the subject would be published.

Inclusion criteria

1. Patients visiting ophthalmology OP
2. Adults
3. Glaucoma patients

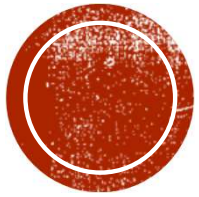
Exclusion criteria

1. Patients suffering from infections like conjunctivitis
2. Patients aged less than 18
3. Non-co-operative patients
4. Communicable corneal pathologies
5. Post op patients
6. Those who opt out of the study

Study	Population and type	NCT-GAT difference	Key findings
Shantanu Das et al	Clinical adults; NCT vs GAT with CCT	~+1 mmHg	NCT values are significantly higher than GAT values in thin and normal corneas whereas it overestimates more in thicker corneas
Tejwani et al	Clinical adults; NCT vs GAT with CCT	−5.0 to + 10.3	Agreement between the devices was statistically insignificant
Aggarwal et al	Adults, NCT vs GAT with CCT	±2.7	The IOP measured by NCT was lower compared to GAT for CCT less than 556 μm

PREVIOUS LITERATURE

Note the variability and inconsistencies between the studies. To address this issue has been among the primary concern for Ophthalmologists



WHAT DID I SEE?

Observations…

Overall Analysis

- NCT: mean 16.07 mmHg, SD 4.07 mmHg.
- GAT: mean 13.97 mmHg, SD 2.36 mmHg.

~2.1 mmHg

The mean CCT observed in the study is ~543 µm

In a total of 56 eyes, CCT > 550 µm

Mean NCT ≈ 18.89 mmHg; SD ≈ 4.19 mmHg.

Mean GAT ≈ 14.11 mmHg; SD ≈ 2.81 mmHg

~4.8 mmHg

Overall sample averages are NCT ≈ 16.1, GAT ≈ 14.0 mmHg

Indicates that in corneas thicker than 550 µm, the positive bias of NCT over GAT roughly doubles compared with the whole cohort (~4.8 vs ~2.1 mmHg)

In this study, a total of 19 eyes showed a difference of more than 5 mmHg between NCT and GAT. The mean difference was +8.75-+9.0 and the mean CCT was 600 µm in both the cases.
This shows that a very large increase in corneal thickness from the mean value of ~543 µm shows an increased positive deviation between GAT and NCT.

Eye	n (eyes)	NCT–GAT difference	Mean CCT
OD	11	+9.0	600.4
OS	8	+8.75	599.8

Age group	n (subjects)	Mean CCT (both eyes) mean ± SD (µm)	Approx. NCT–GAT gap
<30	30	550.1 ± 40.9	~2.55 mmHg
30–39	7	556.7 ± 35.5	~2.00 mmHg
40–49	14	528.1 ± 47.1	~1.71 mmHg
50–59	11	534.5 ± 65.7	~1.31 mmHg
60+	13	543.1 ± 43.0	~2.19 mmHg

Age wise analysis showed no significant variations

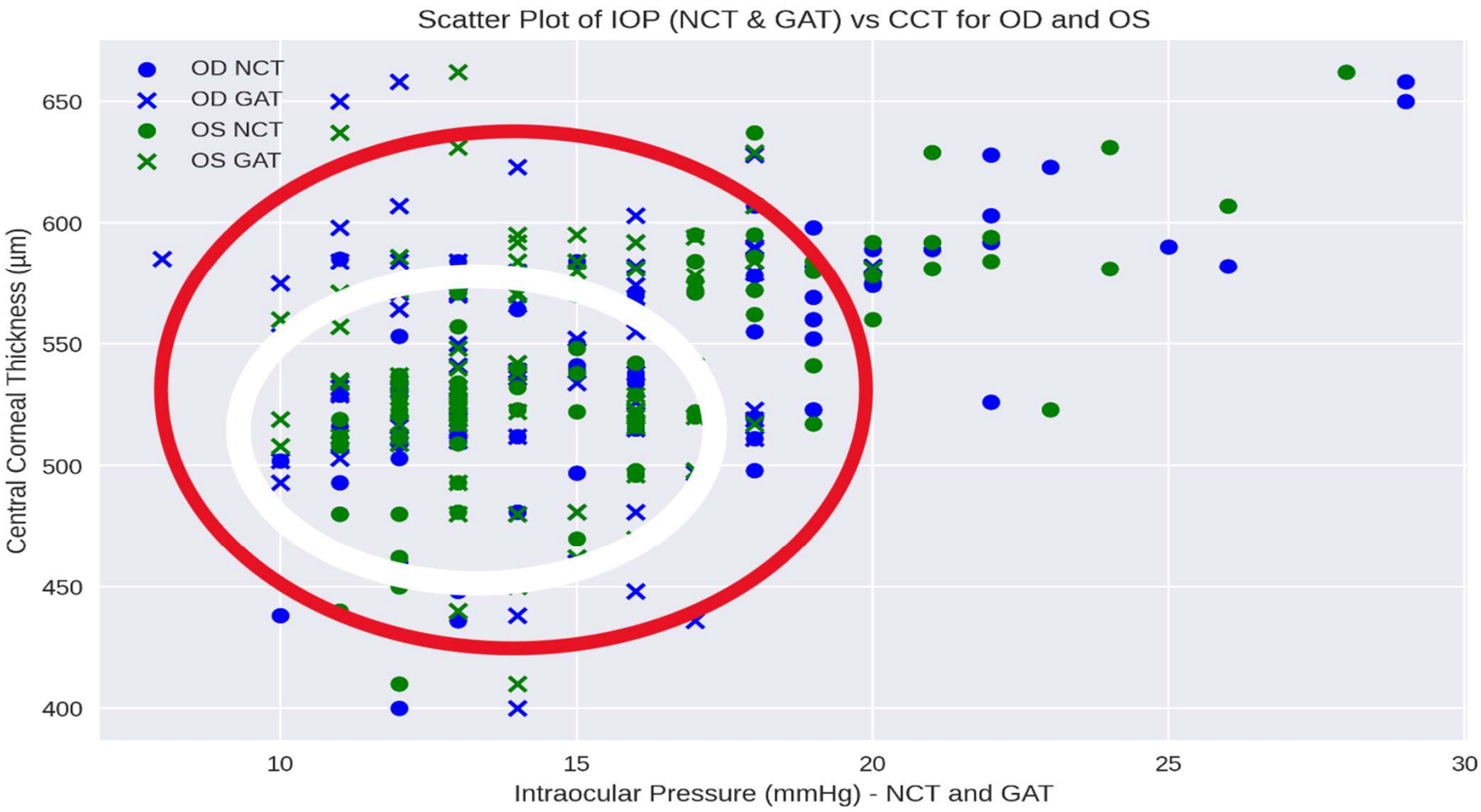
THE OPPOSITE

In a total of 10 subjects (13.33% of the subjects), NCT was noted to be lower than GAT. In all these subjects, the corneal thickness was low (~465 µm)

20 eyes

- OD: 10 eyes had NCT < GAT
- OS: 10 eyes had NCT < GAT

- Mean OD CCT ≈ 463.7 µm (SD ≈ 34.1)
- Mean OS CCT ≈ 469.2 µm (SD ≈ 31.0)


Scatter Plot of IOP (NCT & GAT) vs CCT for OD and OS
OD NCT
OD GAT
OS NCT
OS GAT
Central Corneal Thickness (µm)
650
600
550
500
450
400
10
15
20
25
30
Intraocular Pressure (mmHg) - NCT and GAT

Across the entire dataset, NCT consistently reads higher than GAT by about 3.5 mmHg.

The **95% CI** is narrow (3.2–3.8 mmHg)

Clinically, however, the **limits of agreement (LoA)** are wider.
Thus, individual patients deviate substantially from the average bias.
95% LoA - 0.4 to +7.4 mmHg

EXPECT THE UNEXPECTED

CCT was noted to be higher than average in 3 patients who were recently diagnosed with Glaucoma and prescribed the same medication, while it was in the average range in patients who were chronic patients of Glaucoma.
This was noticed and corroborated with similar observations in other papers.
This necessitates the correlation between CCT and IOP to evaluate the efficacy of treatment for glaucoma.
(Grub M et all report 20 µm increase)

Group	n	Mean CCT	SD	NCT mean	GAT mean
Recent glaucoma (No more than 6 months ago)	3	568.2	8.0	19.5	14
Chronic glaucoma (Diagnosed more than 6 months ago)	6	533.5	36.1	16	13

RESULTS

- Variation in IOP values between NCT and GAT were within acceptable limits when CCT is normal. However in higher ranges of CCT, NCT was greater than GAT and in lower ranges of CCT, NCT was lower.
- CCT values highly affect the value of IOP when measured through NCT.
- It was co-incidentally found while data analysis that CCT was thick in patients recently diagnosed with glaucoma. However, in chronic glaucoma patients, it was normal (average).
- No relation was found between variation of IOP values and CCT changes was found between age in the study population.

DRAWBACKS

- SAMPLE SIZE
  - Ethnic groups
  - My batchmates
  - Accuracy for CCT variation in Glaucoma therapy

CONCLUSION

- It was found that the overall variation between both the methods were statistically insignificant, however, the variations between the methods when CCT values are on the extremes are clinically significant.
- Glaucoma is one such condition wherein accurate measurement of IOP is required. A relation between usage of Glaucoma medication and corneal thickness was identified and compared with similar observations during other studies. This change in CCT value during Glaucoma treatment must be kept in mind before taking steps to evaluate the prognosis of Glaucoma treatment.
- Further research studies are required.

"The ideology behind any medical test performed must be accuracy, economy, ease, comfort and minimal skill level"

RECOMMENDATIONS

- NCT is best used for screening large populations whereas GAT is best for accurate measurements when the data obtained from NCT is abnormal.
- GAT may not be done unnecessarily. NCT must always be the initial test to measure IOP and GAT must be done only upon ambiguous values obtained from NCT.
- The diagnosis of Glaucoma must be confirmed only after GAT and correlating it with CCT. NCT is not at all reliable to diagnose glaucoma.
- After a diagnosis of glaucoma, the efficacy of the medication given must be analysed only after CCT.

INTO THE FUTURE

- Novel methods to measure IOP.
- To assess them along with existing methods and bring about more accuracy.
- Race based and population based studies of CCT.
- Exact time based assessment of CCT variation along with Glaucoma therapy.

"One should not compromise among accuracy, ease and practicality when it comes to diagnostic testing. That must be the aim of novel diagnostic techniques!"

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THANK YOU

The aim of a researcher in medicine is not different from the aim of a clinician. A researcher just jumps ahead more!