What is the best way to measure intraocular pressure (IOP) in a virtual clinic?

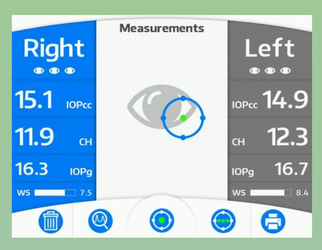
Islam Mostafa (Medical Student), Eleonora Bianchi (Foundation Year), Lyndsay Brown (Senior Research Optometrist), Andrew Tatham (Consultant)
Conducted at: Princess Alexandra Eye Pavilion, Edinburgh

Background:

- Glaucoma is the leading cause of irreversible blindness worldwide[1].
- Patients require lifelong treatment and follow-up. At a population level, this forms a large burden on the NHS[2].
- A proposed strategy: "virtual clinics", is increasingly used nationally, where nurses/optometrists collect patient data, to be reviewed remotely by the ophthalmologist[3].
- This includes *intraocular pressure (IOP)* – the only modifiable risk factor for glaucoma[4].
- Since the consultant is not present during patient visits, it is essential that the clinical information he/she receives is accurate & repeatable. This partly depends on the tool used:

← Goldmann Applanation Tonometer (GAT). Gold standard.

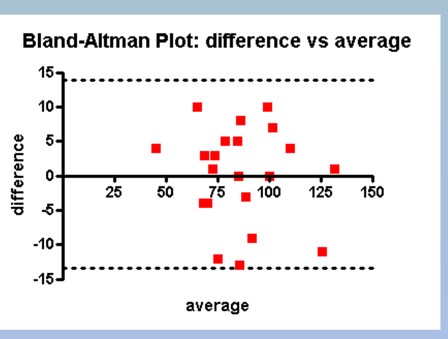
Ocular Response Analyzer® (ORA). Newer alternative. Automated air puff tonometer. →



- Aim: To compare the repeatability of IOP measurements by both GAT and ORA methods to help inform which is the most appropriate for virtual clinics.
- Objectives: To evaluate agreement between:
  - ➢ 1) Ophthalmologists' GAT IOP measurements
  - ➢ 2) Ophthalmic nurses' GAT IOP measurements
  - ➢ 3) ORA IOP measurements

Methods:

- In this prospective study, 116 patients visiting the glaucoma clinic had their IOP measured by all 3 methods: the ophthalmologist and nurse using GAT and a technician using ORA (IOPg).
- For 94 of those patients, the technician then repeated the measurement process to record repeat ORA values.
- The order of testing was random & doctors and nurses were blinded to each other's GAT results.
- Agreement among these groups as well as among repeat ORA measurements were analysed using Bland-Altman plots of difference against mean, with 95% limits of agreement (LoA) being calculated.

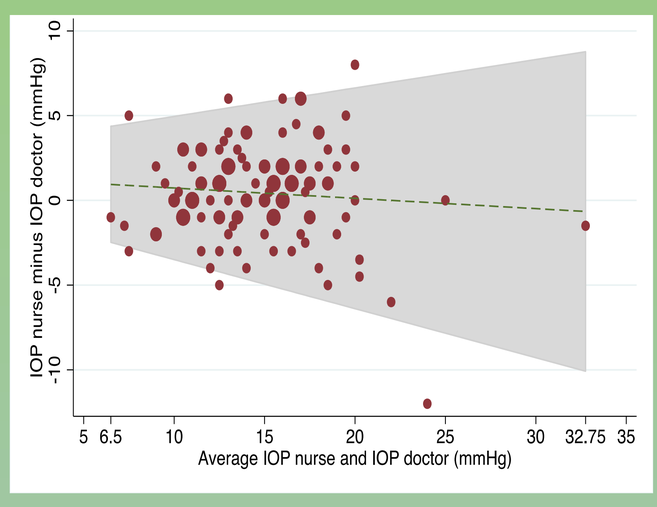


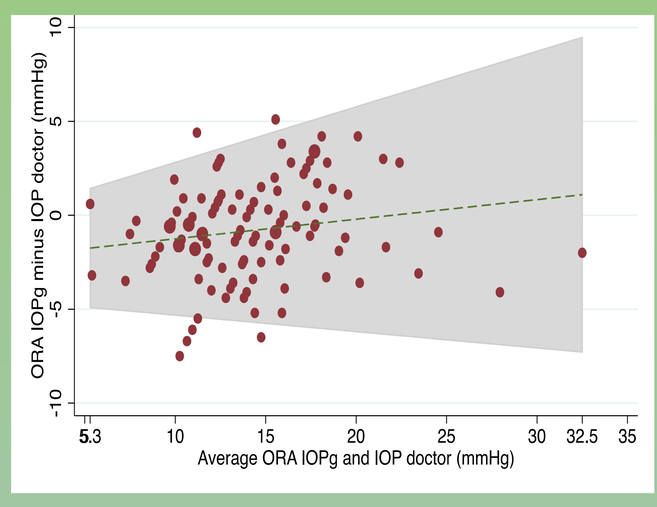
- Bland-Altman plots are a graphical method of comparing 2 measurement techniques.
- On the y-axis: plot the difference between the methods (e.g. Nurse GAT – Doctor GAT).
- On the x-axis: plot the average of the 2 methods (e.g. Mean of Nurse and Doctor GAT).
- Can also show where 95% of any difference between the two methods is likely to lie by drawing 95% "limits of agreement" lines.

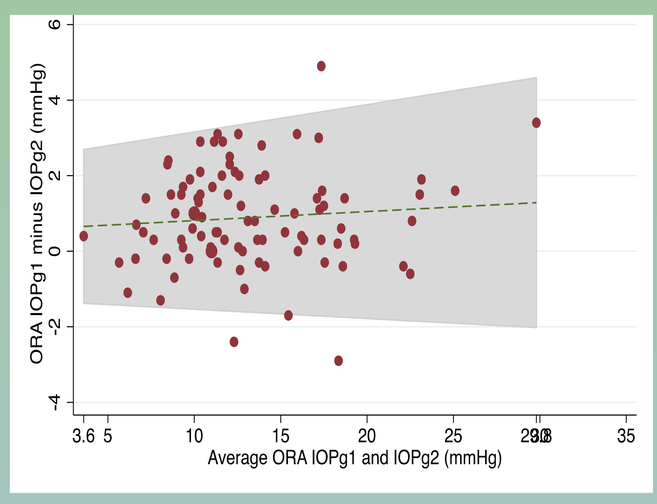
- Repeatability was also assessed by calculating average measures intraclass correlations (ICC; 2-way mixed). For this, we treated the ophthalmologist and nurse IOPs as repeat GAT measurements.

Results & Discussion:

Nurse GAT vs Doctor GAT	ORA IOPg vs Doctor GAT	ORA IOPg vs repeat ORA IOPg
95% Limits of Agreement: **± 5.21** mmHg for the sample average IOP of 14.78 mmHg	95% Limits of Agreement: **± 4.93** mmHg for the sample average IOP of 14.17mmHg .	95% Limits of Agreement: **± 2.52** mmHg for the sample average IOP of 13.28 mmHg.







Repeated measurement	Intraclass Correlation Coefficient (ICC)
GAT	0.863
ORA IOPg	0.972

- There was no evidence of proportional bias in any comparison.
- Better agreement was shown between repeat ORA IOPg than repeat GAT measurements.
- The finding of **± 5.21** mmHg could be concerning since the Early Manifest Glaucoma Study found that progression risk decreased by about 10% with each 1 mmHg reduction[5].
- The Bland-Altman plots also highlighted isolated differences in measurements falling outside the 95% limits of agreement.
  - ➢ Some of these could have important clinical implications. *For example, one patient had a Nurse GAT score of 18 mm Hg, a Doctor GAT score of 30 mm Hg and an ORA IOPg of 25.9 mmHg.*
- The intraclass correlation coefficient (ICC) results further showed better agreement between repeat IOPg measurements than between repeat measurements of GAT.
- In addition to providing more repeatable results, ORA has other advantages, such as a lower chance of infection (as it is non-contact), no need for anaesthetic drops and requiring little training.
- Interestingly, the quality of individual ORA measurements ("wave score") was found not to be a confounding factor – this may be due to ORA's "intelligent averaging" option, whereby measurements outside a certain quality range are automatically excluded[6].

❖ Limitations:
- ❖ Ideally we wanted to compare repeat GAT with repeat ORA but this was not possible in the busy clinics. We compensated by treating the ophthalmic nurse and ophthalmologist GAT measurements as a GAT repeat and comparing them to the repeat ORA measurements.
- ❖ We did not use the gold standard 2-person masked technique for GAT research as this study was conducted in a normal clinical environment.

Conclusions:

- A key requirement of clinical measures in virtual clinics is that they are repeatable to provide the remote ophthalmologist with reliable data.
- This study has shown that under normal clinical conditions measurements from GAT have poor agreement when performed by different operators.
- In contrast, repeat Ocular Response Analyzer® IOPg measurements showed better 95% agreement limits of ± 2.52 mmHg.
- We recommend further studies to investigate the financial cost-benefit analysis of expanding the use of ORA within virtual clinics nationally.

References:

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