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Introduction

- Cases of glaucoma in the UK are mostly identified through routine examinations by community/primary care optometrists.^{1,2}
- Elevated Intraocular Pressure (IOP) is an important risk factor for glaucoma.³
- Goldmann Applanation Tonometry (GAT) is regarded as the reference method for IOP measurement.⁴
- UK community optometrists principally use non-contact or rebound tonometry to measure IOP.^{5,6} Knowledge of how these devices agree with GAT would help inform their choice of tonometer and potentially reduce the number of false positive referrals.

Purpose

- To assess the agreement of three tonometers commonly used by UK community optometrists with GAT.

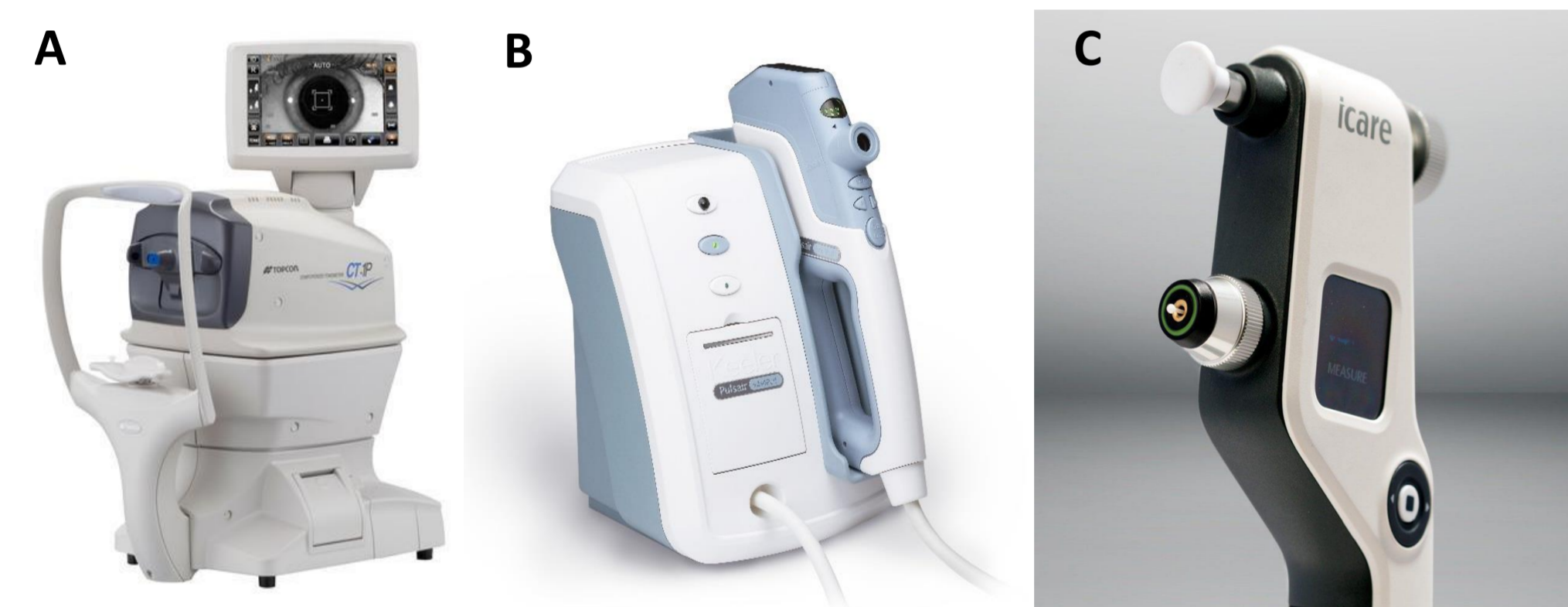


Figure 1: Tonometers assessed for their agreement with GAT
A: CT-1P Non-Contact Tonometer (NCT) (Topcon, Topcon Corporation, Tokyo, Japan).
B: Pulsair IntelliPuff (Keeler Ltd., Windsor, UK).
C: Icare rebound tonometer (Icare®, Helsinki, Finland).

Methods

- Participants, 18 years and over, were recruited from a university eye clinic.
- IOP was measured by two research optometrists (RO1 and RO2), both experienced in GAT.
- IOP was first measured on the randomly selected study eye (SE1) using the three tonometers, NCT, Pulsair and Icare (Figure 1) by RO1.
- GAT readings were then obtained in a masked manner by RO1. The force on the probe was initially set at a randomly selected value between 1g and 2g by RO2; RO1, masked to the dial reading, adjusted the probe until the end point, and RO2 recorded the measurement.

- Agreement between NCT, Pulsair, Icare and GAT was assessed using Bland–Altman difference analysis, and mean differences and 95% limits of agreement (LoA) of measurements calculated.
- Percentages of IOP readings within ± 2 mmHg of the GAT reading were obtained.

Results

- Forty-one participants had their IOP measured by all four tonometers: median age 36 years (IQR: 20, 49), 71% female.
- Figure 2 displays the Bland-Altman plots for each tonometer compared to GAT and the percentage of readings within ± 2 mmHg of GAT.
- Table 1 outlines the results for each tonometer compared to GAT.

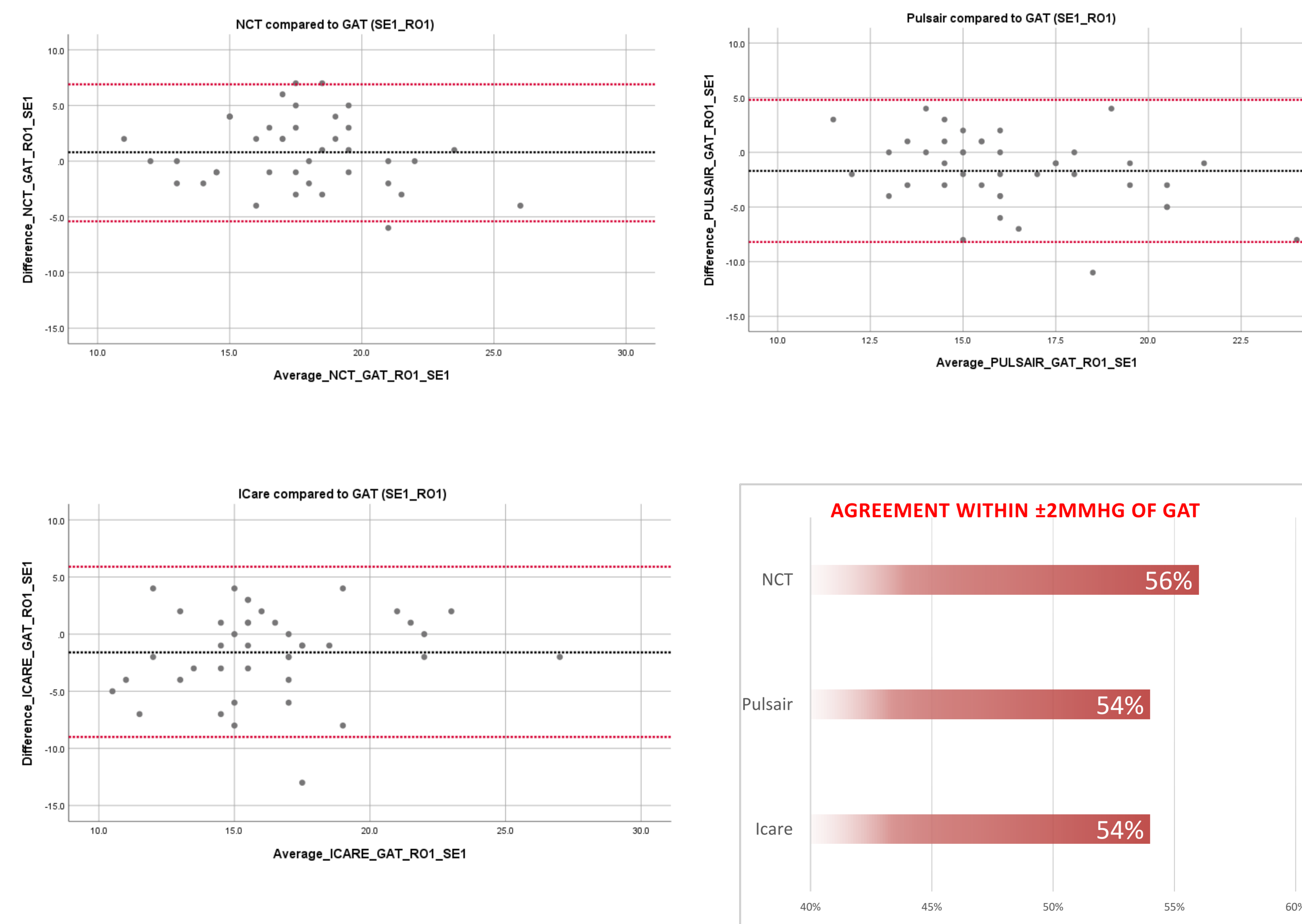


Figure 2: Bland–Altman difference plots and % Agreement for NCT, Pulsair and Icare compared to GAT

Tonometer	Mean (SD) IOP (mmHg)	Mean Bias: Tonometer-GAT IOP (mmHg)	95% LoA (mmHg)	P value (F Test)
GAT	17.1 (3.7)	-	-	-
NCT	17.9 (3.2)	0.8	-5.4 to 6.9	0.21
Pulsair	15.4 (2.6)	-1.7	-8.2 to 4.8	0.01
Icare	15.6 (4.2)	-1.6	-9.0 to 5.9	0.22

Table 1 Comparison of each tonometer to GAT (95% LoA: Limits of Agreement)

Conclusions

- For three tonometers commonly used by UK community/primary care optometrists we found over half of measurements were within ± 2 mmHg of GAT, with NCT having the greatest percentage of measurements within ± 2 mmHg. These findings concur with previous studies.⁴
- Pulsair and Icare recorded mean IOP lower than GAT, and there was a statistically significant difference between mean IOPs for Pulsair vs GAT. Both these devices had wider 95% LoA than NCT.
- Our results agreed with other researchers who found Icare to underestimate IOP⁷ more so when $GAT \geq 23$ mmHg.⁸
- Further work is needed to investigate the clinical impact of the choice of tonometer used in the detection of patients at risk of glaucoma, although IOP alone is not a good indicator of glaucoma.⁹

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