Comparison of CT800 non-contact tonometer and Perkins applanation tonometer in community practices

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Declaration

Recipient of KOS Travel Grant
NO conflict of interest/finance
Objectives

- Estimated 76.0 million of worldwide population will suffer from glaucoma by year 2020\(^1\)
  1. Compared CT800 non-contact tonometer to the Perkins applanation (handheld reference method) during eye screening
  2. To demonstrate the agreement between these two instruments


Methods

- A cross sectional, non-interventional study 1 April-31 May 2017
- **Inclusion criteria**: Subject attended eye screenings
- **Exclusion criteria**: corneal scar, corneal pathology, active ocular infective disease, recent intraocular surgery, glaucoma patients, allergic to topical anaesthetic drop.
- IOP measurement by computerised tonometer CT 800 non-contact tonometer (Topcon, Japan) was done first by an optician in sitting position. Three measurements were done on the right eye followed by the left eye without topical anaesthetic drop. The average of three measurements was taken for analysis.
Method

- After 1/2 hour, IOP measurement was read using Perkins MK3 applanation tonometer (Haag-Streit, UK) by a single ophthalmologist who was masked about NCT IOP reading. Each eye was instilled with an anaesthetic agent (proparacaine 5%) and application of fluorescein 1%.
- Subjective preference of measurement methods by subject was documented.
Results

- A total of 687 eyes of from 344 subjects were recruited.
- The mean age of subjects was 42.3±18.48 years and the range was 7 to 82 years.
- 66% of subjects were female.

**Descriptive Statistics**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean (mmHg)</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAT</td>
<td>687</td>
<td>9.0</td>
<td>21.0</td>
<td>13.21</td>
<td>2.27</td>
</tr>
<tr>
<td>NCT</td>
<td>687</td>
<td>10.0</td>
<td>25.0</td>
<td>16.30</td>
<td>2.68</td>
</tr>
</tbody>
</table>

PAT: Perkins applanation tonometer
NCT: Non-contact tonometer

Pearson’s correlation coefficient showed a moderate positive correlation of +0.494 between the two methods of IOP measurement \((r=+0.494, \ p<0.001)\).

A linear regression analysis of PAT versus NCT measurements revealed a slope of 0.42 with an square of 0.244.
One-Sample paired t-test

<table>
<thead>
<tr>
<th>Diff</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>687</td>
<td>-3.09</td>
<td>2.52</td>
<td>.096</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Paired t-test showed significant overall difference between two instruments (p<0.001).

The mean difference between PAT and NCT was 3.09, standard deviation of 2.52mmHg. Overall, NCT measures measured 3.09mmHg higher than Perkins.

The limit of agreement was calculated as -8.02 to 1.84 mmHg with 1.96 standard deviation of either side of mean difference.

Bland-altman plot showed fair agreement for both methods of IOP reading.

Subjectively, 69.8% of subjects preferred Perkins tonometry measurement than CT 800 NCT.
Discussion

1. Why Perkins measures lower IOP than CT800 non-contact tonometer?

Perkins
- operator dependent
- one IOP reading
- ocular massage effect
- topical LA

2. Perkins versus CT800 NCT during community eye screening

<table>
<thead>
<tr>
<th>Perkins</th>
<th>CT800 NCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheaper</td>
<td>More expensive</td>
</tr>
<tr>
<td>Handy</td>
<td>Slight bulky</td>
</tr>
<tr>
<td>Slower</td>
<td>Faster</td>
</tr>
<tr>
<td>Eye doctor</td>
<td>Paramedic</td>
</tr>
<tr>
<td>Risk of cross infection</td>
<td>Rare</td>
</tr>
<tr>
<td>Need topical LA and fluorescein</td>
<td>Air puff</td>
</tr>
</tbody>
</table>

### Discussion

Studies compare Perkins tonometer with non contact tonometer

<table>
<thead>
<tr>
<th>Author</th>
<th>subject</th>
<th>Eyes</th>
<th>method</th>
<th>Correlation</th>
<th>Mean Perkins (mmHg)</th>
<th>Mean NCT (mmHg)</th>
<th>Bias &amp; SD</th>
<th>95% LoA (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricker et al (1990)</td>
<td>30</td>
<td>-</td>
<td>Keeler pulsair vs Perkins</td>
<td>R=0.92, p&lt;0.001</td>
<td>Not done</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prabhakar et al (2013)</td>
<td>83</td>
<td>166</td>
<td>Keeler pulsair vs Perkins</td>
<td>R=0.510</td>
<td>13.06</td>
<td>14.53</td>
<td>-1.47/nil</td>
<td>-4.5 to 7.5</td>
</tr>
<tr>
<td>Ragarajan S et al (2016)</td>
<td>400</td>
<td>800</td>
<td>Canon TX:10 vs Perkins</td>
<td></td>
<td>13.8</td>
<td>13.9</td>
<td>-0.02/3.9</td>
<td>-7.67 to 7.64</td>
</tr>
<tr>
<td>Our study (2017)</td>
<td>344</td>
<td>687</td>
<td>CT 800 vs Perkins</td>
<td>R=0.494, p&lt;0.001</td>
<td>13.21</td>
<td>16.30</td>
<td>-3.09/2.52</td>
<td>-8.02 to 1.84</td>
</tr>
</tbody>
</table>

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**Discussion**

- Ogbuehi compared Topcon CT80 non-contact tonometer, the older generation, with the Goldmann applanation tonometer.
- Topcon CT80 read 0.2 ± 1.5 mmHg higher than Goldmann.
- The 95% limit of agreement were -3.14 and +2.74 mmHg.
- Ogbuehi concluded that Topcon CT 80 NCT can be used as an objective clinical method to assess normal intraocular pressure.

Limitation
1. Small sample sizes
2. Narrow range of intraocular pressure were recruited
3. Cornea factor eg CCT, astigmatism not studied

Conclusions
1. CT 800 non contact tonometer is a fair screening tool in community practice.

2. There was statistically significant difference in IOP reading between CT 800 NCT and Perkins applanation with CT 800 NCT read 3.09mmHg higher than Perkins applanation tonometer.

3. We would suggest to get a confirmation IOP reading by Goldman applanation tonometer when non-contact tonometer read high IOP values.