The Dyop: a New Test of Visual Acuity

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The authors have no financial interest in the DYOP. The DYOP was donated to Hadassah Academic College for use in research.
Introduction

• 1862: Herman Snellen developed the first eye chart
• 1976: Ian Bailey and Jan Lovie-Kitchin developed the LogMar chart
• Measuring visual acuity (VA) by optotype recognition has remained unchanged for more than 150 years
• Is it time for a change?

Logmar charts: disadvantages

- Measures **static** acuity
- Measures *quantitative* VA not *qualitative* VA
- End-point is often difficult to ascertain, with a patient able to identify some optotypes on several different lines

The development of a “reduced logMAR” visual acuity chart for use in routine clinical practice
Solution: DYOP?

• A segmented optotype that can rotate clockwise or anticlockwise.
• VA threshold is measured with DYOPs
  • Choice of color, contrast, and speed rotation
  • Diameter decreased until the direction of motion can no longer be recognized.

Testing visual acuity with Dyop
Advantages of DYOP

• No problems of:
  • Literacy
  • Memorizing
  • Crowding
• Enables a more precise endpoint
• No limit to the number of times different DYOPs can be shown for a given line of VA
• Utilizes dynamic visual acuity

Previous studies of DYOP:

• Hayes et al., 2011:
  the DYOP has a clearer endpoint threshold than Landolt C

• Harris & Keim, 2015:
  high correlation between DYOP and Logmar charts
  quicker and more precise endpoint of acuity using DYOP

• Sum & Woo, 2017:
  similar VA scores for the same subjective refraction values with DYOP and
  LogMAR chart in adults.
Can the Dyop replace the traditional test charts?

HAC undertook a research project to test:

- repeatability (intra-test)
- reproducibility (inter-test)
- speed of exam
- the subjective experience of the participants
Methods

Subjects:
- n = 36, healthy
- 31 women, mean age: 26.83±6.79, range: 22-54 years

Procedure:
- Monocular right eye VA
- 3 consecutive measurements with the LogMAR and DYOP charts, in random order.
- Comparative subjective questionnaire
- Coefficient of repeatability was calculated to assess intra-test repeatability.
- Reproducibility: repeating the measurements after 1-2 weeks and analyzing with correlation, paired t-tests and Bland and Altman analysis.
## Results: Objective

<table>
<thead>
<tr>
<th>Agreement and Repeatability</th>
<th>DYOP</th>
<th>LogMAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean VA (Log Units)</td>
<td>0.03±0.13</td>
<td>-0.02±0.15</td>
</tr>
<tr>
<td>Mean Standard Deviation (Log Units)</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Coefficient of Repeatability</td>
<td>0.44</td>
<td>0.51</td>
</tr>
<tr>
<td>Mean Difference (Log units)</td>
<td>0.05±0.07</td>
<td></td>
</tr>
<tr>
<td>95% LOA (Log units)</td>
<td>-0.08 – 0.17</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Correlation</td>
<td>0.90</td>
<td></td>
</tr>
</tbody>
</table>
Results: Objective

Bland and Altman: Agreement

Mean Difference: 0.05±0.07

Mean: 0.17

Difference (DYOP - LogMAR) (Log units)

Mean (Log units)
Results: Objective

<table>
<thead>
<tr>
<th>Inter Test Repeatability (Reproducibility)</th>
<th>DYOP</th>
<th>LogMAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean VA Session 1 (Log units)</td>
<td>0.03±0.13</td>
<td>-0.02±0.15</td>
</tr>
<tr>
<td>Mean VA Session 2 (Log units)</td>
<td>-0.01±0.12</td>
<td>-0.01±0.16</td>
</tr>
<tr>
<td>Mean Difference (Log units)</td>
<td>0.04±0.04</td>
<td>0±0.05</td>
</tr>
<tr>
<td>Correlation</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.0001</td>
<td>0.59</td>
</tr>
</tbody>
</table>
Results: Subjective

Did you feel frustrated during the test?

<table>
<thead>
<tr>
<th>T-Test</th>
<th>LogMAR</th>
<th>DYOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=0.06</td>
<td>1.50±1.02</td>
<td>2.00±1.25</td>
</tr>
</tbody>
</table>
Results: Subjective

Was the test tiring?

<table>
<thead>
<tr>
<th>T-Test</th>
<th>LogMAR</th>
<th>DYOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=0.47</td>
<td>1.58±1.04</td>
<td>1.73±1.08</td>
</tr>
</tbody>
</table>
Results: Subjective

Did you understand the test?

<table>
<thead>
<tr>
<th>T-Test</th>
<th>LogMAR</th>
<th>DYOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=1.00</td>
<td>4.97±0.17</td>
<td>4.97±0.17</td>
</tr>
</tbody>
</table>
Results: Subjective

Did you feel sure of your answers?

<table>
<thead>
<tr>
<th></th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>3</td>
</tr>
<tr>
<td>Neutral</td>
<td>9</td>
</tr>
<tr>
<td>Agree</td>
<td>13</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>3</td>
</tr>
</tbody>
</table>

T-Test

<table>
<thead>
<tr>
<th>Test</th>
<th>LogMAR</th>
<th>DYOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=0.33</td>
<td>4.29±1.00</td>
<td>4.47±0.66</td>
</tr>
</tbody>
</table>
Conclusions:

✓ LogMAR and DYOP charts are interchangeable for VA based on the mean difference
✓ The Dyop does have acceptable repeatability and reproducibility
✓ Dyop examination was on average 18 seconds longer: not clinically significant
✓ Dyop examination seems to be more sensitive for changes in VA

BUT

× Subjects prefer the standard LogMAR examination, possibly due to its familiarity.
Can the Dyop replace the traditional test charts?
Thank you for your attention

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