BACKGROUND

Many methods of heterophoria measurement are clinically available. Several studies have been carried out to compare their results. Due to the difference of the methods in the ability to control accommodation, the induced proximal convergence, the technique used for dissociation, and the method of data analysis\(^1\), the results can vary on the same patient.

The aim of this study is to determine the reliability and compare reproducibility of different dissociated phoria measure tests: Modified Thornton, Von Graefe, and “fast” and “slow” Cover Test. For that purpose, I designed a specific protocol, in order to control and equate test conditions.

METHOD

Initial examination

- Anamnesis
- Monocular VA
- Retinoscopy
- Titmus stereopsis test
- Unilateral Cover Test
- Maddox test with the rods in vertical

Conclusions

In order to avoid examiner bias, every objective test was combined with subjective ones.

- Refraction: retinoscopy vs. subjective refraction
- Stereopsis: Ensure absence of strabismus or microstrabismus
- Use best corrected refraction in spectacles or contact lenses.

Clinical approach

- * Perform each test 3 times
- * Allow binocular vision between measures.
- * As an accommodative control stimulus, use a near acuity chart (VA 20/30) at 40cm
- * Lighting conditions: dimmer while performing Modified Thornton. That way, we help visualize the red rod.

SAMPLE

Inclusion criteria

- Patients aged 8 to 40 years old.
- Men and women.
- Myopic, hyperopic and emmetropic patients.

Exclusion criteria

- Visual acuity — Snellen chart VA < 20/25 (eccentric fixation patients excluded)
- VA difference between eyes higher than one line (amblyopia excluded)
- Presbyopia (near VA < 20/20)
- Strabismus or previous strabismus surgery
- Central suppression presence
- Vertical deviation > 2dp (Maddox test)
- Stereopsis (Randot) > 40°
- Ocular health — Aphakic or pseudoaphakic patients

RESULTS

31 non-presbyopic patients were enrolled in this study. 11 of them were optometrists. Mean age was 23.2 ± 3.9 (SD) years.

Table 1. Statistical Analysis (\(^\)\)

<table>
<thead>
<tr>
<th>Method</th>
<th>Avg ((\mu))</th>
<th>SD ((\sigma))</th>
<th>FAC*</th>
<th>KCC**</th>
<th>Max ((\mu))</th>
<th>Min ((\mu))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Thornton</td>
<td>1.78</td>
<td>6.99</td>
<td>-0.21</td>
<td>-2.24</td>
<td>7</td>
<td>-8</td>
</tr>
<tr>
<td>Von Graefe</td>
<td>3.22</td>
<td>7.8</td>
<td>0.31</td>
<td>-1.86</td>
<td>16</td>
<td>-4</td>
</tr>
<tr>
<td>Fast CT</td>
<td>2.19</td>
<td>7.13</td>
<td>-0.20</td>
<td>-2.28</td>
<td>8</td>
<td>-6</td>
</tr>
<tr>
<td>Slow CT</td>
<td>2.5</td>
<td>8.56</td>
<td>-0.47</td>
<td>-2.24</td>
<td>8</td>
<td>-9</td>
</tr>
</tbody>
</table>

\(^\text{1}\) FAC: Fisher asymmetry coefficient \(^\text{2}\) KCC: Kurtosis coefficient

Table 2. Intraclass correlation coefficient among measures (repeatability)

<table>
<thead>
<tr>
<th>Measure 1</th>
<th>Measure 2</th>
<th>Measure 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Thornton</td>
<td>0.975</td>
<td>0.947</td>
</tr>
<tr>
<td>Von Graefe</td>
<td>0.634</td>
<td>0.684</td>
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<tr>
<td>Fast CT</td>
<td>0.981</td>
<td>0.959</td>
</tr>
<tr>
<td>Slow CT</td>
<td>0.969</td>
<td>0.976</td>
</tr>
</tbody>
</table>

Table 3. Intraclass correlation coefficient among methods (reliability)

<table>
<thead>
<tr>
<th>Fast CT</th>
<th>Slow CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Thornton</td>
<td>0.85</td>
</tr>
<tr>
<td>Von Graefe</td>
<td>0.64</td>
</tr>
</tbody>
</table>

\(^\text{1}\) IL: Inferior limit \(^\text{2}\) SL: Superior limit

CONCLUSION

Cover Test and Modified Thornton are two reliable methods of measuring phoria\(^2\) and they offer similar results in normal binocular vision subjects. The difference in prismatic dioptres between Fast Cover Test and Modified Thornton is not clinically significant. These two methods are equivalent.

Von Graefe shows more variability\(^2\), and yields higher values of exophoria\(^4\). The use of prismopter can trigger this\(^2\)

Slow CT unmasks higher amounts of phoria than Fast CT. Cover Test is the unique method that allows assessing the fusional stability, varying the occlusion period and estimating the time of recovery.

BIBLIOGRAPHY

5. CASILLAS E, ROSENFIELD M. Comparison of subjective heterophoria testing with a prismopter and trial frame. Optom Vis Sci 2006;83:237-41