The Effect of Interocular Disparity on Binocular Summation

Kurt Moody, OD, FAAO, FBCLA
Director; Clinical New Product Development
Johnson & Johnson Vision Care
Background

- Employing interocular disparity or monovision is a common practice to extend the depth of focus for presbyopic patients.
- Most multifocal fitting guides will also introduce interocular disparity to enhance near vision.
- As interocular disparity is introduced it can have an effect on binocular acuity.
  - 10 subjects aged 17-28
  - Monocular and binocular csf at 6c/deg
  - All subjects corrected to 6/6
  - Right eye was selected as the eye to be defocused with left eye always best corrected
  - Prior work showed no difference in csf between eyes when optimally corrected
Measuring Vision

Typical CSF Systems
AST Sentio Platform - qCSF

• A distance vision clinical testing system*:
  – Display, cart, tablet
  – Software – qCSF algorithm
  – Near qCSF under-development

• What’s unique*:
  – Hybrid letter-grating stimulus
    • Sloan letters bandpass-filtered with a raised cosine window, with peak frequency 4 cycles per letter
  – Bayesian adaptive testing

Rapid and Precise

* Adaptive Sensory Technology© website
AST Sentio Platform - qCSF
Current Study Design

• Intent – What is the relationship of binocular contrast sensitivity as interocular disparity is created

• Population – Presbyopic subjects with a best correction of 20/20 in both eyes and a near add between +2.00D to +2.75D, N= 61

• CSF (AST Sentio Platform*) of 1.5 – 18 c/deg measured at 4 M under dim illumination (<2.5 lux) with trail frames

• Dominant eye is determined by sensory method, non-dominant eye to be defocused in increments of 0, +0.50D, +1.00D, +1.50D and +2.00D

• Same non-dominant increments when dominant eye is defocused by +0.25D and -0.25D

• Subjective vision captured via 7 point Likert (subjective) scale

• Summation is binocular /dominate eye expressed as a percentage.

* Adaptive Sensory Technology© has developed the AST Sentio Platform for clinical testing of contrast sensitivity; incorporating the qCSF algorithm aimed to improve usability and comfort while maintaining laboratory-grade precision of the test.
Binocular AULCSF * As Dominant Eye Defocus Varies with Non-Dominant Eye Disparities

Importance of correct identification of dominant eye and an accurate refraction

* Area Under the Log Contrast Sensitivity Function
Summation as Interocular Disparity Changes and Dominant Eye Has 0.00D Defocus

Summation = Binocular AULCSF/Dominate Eye
AULCSF
Expressed as a percentage

Non Dominant Eye Disparity (D)

AULCSF Summation %
Contrast Sensitivity Functions When Dominant Eye Has 0.00D Defocus
Subjective Assessment of Vision

- Subjective refraction – binocular balance
- Spherocylindrical correction in light weight trail frame
- Distance target in ambient light – subjective feedback with “extra lenses” after 2 trails
- 7 point Likert scale

<table>
<thead>
<tr>
<th>Intensity Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much Worse</td>
<td>-3</td>
</tr>
<tr>
<td>Moderately Worse</td>
<td>-2</td>
</tr>
<tr>
<td>Slightly Worse</td>
<td>-1</td>
</tr>
<tr>
<td>None - Same</td>
<td>0</td>
</tr>
<tr>
<td>Slightly Better</td>
<td>1</td>
</tr>
<tr>
<td>Moderately Better</td>
<td>2</td>
</tr>
<tr>
<td>Much Better</td>
<td>3</td>
</tr>
</tbody>
</table>
Subjective Vision Data

<table>
<thead>
<tr>
<th>Disparity</th>
<th>Dom Eye 0.0D</th>
<th>Dom Eye -0.25D</th>
<th>Dom Eye +0.25D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 D</td>
<td>0.46</td>
<td>0.39</td>
<td>0.20</td>
</tr>
<tr>
<td>+0.50D</td>
<td>-0.23</td>
<td>-0.30</td>
<td>-0.46</td>
</tr>
<tr>
<td>+1.00D</td>
<td>-0.75</td>
<td>-0.84</td>
<td>-0.85</td>
</tr>
<tr>
<td>+1.50D</td>
<td>-0.85</td>
<td>-0.89</td>
<td>-1.08</td>
</tr>
<tr>
<td>+2.00 D</td>
<td>-1.13</td>
<td>-0.87</td>
<td>-1.51</td>
</tr>
</tbody>
</table>
AULCSF Correlation to Subjective Vision Scores

0.0 D Dominate Eye Disparity

Subjective Scores

AULCSF

Non Dominant Eye Disparity (D)
AULCSF Correlation to Subjective Vision Scores

Subjective Scores vs AULCSF

$R^2 = 0.9697$  
0.0 D Dominate Eye Disparity
Ocular Dominance Demonstration

• Sighting Dominance

• Sensory Dominance
Conclusions

• Correct identification of dominant eye is critical to maximize summation.
• To maximize summation dominant eye should not be given additional plus; criticality of accurate refraction.
• +1.00D or greater interocular disparity creates a significant drop in distance summation.
• Up to +0.50D of disparity when the dominant eye is optimized appears to be acceptable in regard to bilateral summation and CS
• There is a strong correlation of subjective vision and AULCSF
Thank you

kmoody1@its.jnj.com