Eleven Pearls for the Low Vision Evaluation

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Disclosure Statement:
• Nothing to disclose

Objectives

At the completion of this course, the participant will be able to:
• Understand the importance of discussing the functional implications of the eye disease.
• Understand the differences between Galilean and Keplerian telescopes regarding ease of aiming.
• Use the closed circuit television to determine an appropriate power for a stand magnifier.
• Discuss methods for making the refraction more effective.
• Discuss when bar magnifiers may have advantages over spherical stand magnifiers.

#1 Be flexible with refraction techniques

• Just noticeable difference (JND)
• Illumination levels
• Refraction options
• Use working distance with known add power to estimate accuracy of distance Rx

Respect just noticeable difference (JND)... but don’t be limited by it

• Large interval JND changes
  – JND = (denominator of Snellen acuity with 20 in numerator)/100
  – Example: VA 10/200 ⇒ 20/400
    JND: 400/100 = 4.00 D
    Use +/- 2.00 D
  – If patient can’t respond that either change makes it worse, try larger interval, maybe +/- 3.00 D

Respect just noticeable difference (JND)... but don’t be limited by it

• Large interval JCC
  – 20/40 or better ± 0.25
  – 20/50-20/100 ± 0.50
  – Poorer than 20/100 ± 1.00 (or greater)

Illumination levels

• Be sensitive to patient preference for chart/room illumination
  – Higher levels are often helpful for macular degeneration
  – Dim levels for rod monochromats, or others who like less light
• Avoid glare
  – Well directed illumination
  – Well shielded illumination
• Educate while testing!
Refraction options

- Phoropter
  - Stable
  - Comfortable
  - Large interval lens changes clumsy
    - Unless trial lenses used
  - Limited allowance for eccentric viewing
  - Head turn to null point for nystagmus
  - Pantoscopic tilt (PT)
    - Plus lens: ↑ PT ⇒ ↑ + cyl X 180
    - Minus lens: ↑ PT ⇒ ↑ - cyl X 180
  - Difficulty monitoring for eccentric viewing

#1 Be flexible with refraction techniques

Refraction options – Trial frame

- Large lens changes convenient
  - Consider lens flippers
- Allows eccentric viewing
- Troublesome if trial frame does not fit in focimeter to determine power
- Allows habitual head position

#1 Be flexible with refraction techniques

Refraction options – Trial lens clips

- Helpful for high power corrections with existing glasses with vertex distance already set.
- Stability of loose cylinders potentially troublesome
- Sometimes difficult to fit in focimeter.

#1 Be flexible with refraction techniques

Use working distance with known add power to estimate accuracy of distance Rx

- Example: 80 year old pt wears +3.00 add, but holds print at 20 cm for best near visual acuity.
  - Effective add is 1/0.20 m = +5 D
- Likely that the distance power of the glasses is over-plussed by approximately 2 D
- Also consider far point location to estimate amount of myopia.
  - 86 yo sc clearest reading distance = 25 cm
  - 1/.25 m ⇒ 4 D myopia

#1 Be flexible with refraction techniques

#2 Use log MAR (Minimum angle of resolution) charts for refraction when possible.

- Multiple letters
- Portable charts allow several letters at the acuity level
- Similar legibility
  - Constant proportional change in letter size between lines
  - Constant proportional spacing between letters
    - Geometric
    - Every 3 lines changes size by factor of 2

#2 Use log MAR charts.

#3 Be prepared to discuss the physical and functional characteristics of the eye disease.

- Don’t assume this has been done to patient’s level of understanding.
- Patient angst and uncertainty is an important issue.
Describe the expected
- Gives patient confidence that the suggestions from the examination are founded on an understanding of the patient’s situation.
• Blind spots
• Color vision decline
• Jumpy vision
• Glare
• Poor dark adaptation
• Poor contrast
• Interference of poorer eye on binocular vision

#3 Be prepared to discuss the physical and functional characteristics of the eye

#4 Use closed circuit television to determine the equivalent power needed for reading.
• When large amounts of magnification are needed for reading, but patient struggles during testing with high add.
• Determine electronic magnification (EM) needed for fluent reading.
• \( F_{eq} = \text{add} \times \text{EM} \)

#4 Use CCTV to determine equivalent power needed for reading.

Example: Newsprint read fluently 50 cm from screen. Image on screen is 12X larger than newsprint.
• \( F_{eq} = \text{add} \times \text{EM} \)
• \( F_{eq} = (2 \text{ D}) \times 12 = 24 \text{ D} \)
• Find enlargement ratio (ER) needed for a stand magnifier (SM), for example, if patient wears +3.00 D add
  \( F_{eq} = +24 \text{ D} = \text{add} \times \text{ER} \)
  \( \text{ER} = (24 \text{ D}) / (+3 \text{D}) = 8 \)
• Select SM with ER equal to or larger than the calculated ER.
  See Berkeley "Low Vision Yellow Pages" (Bailey I et al)
  http://optometry.berkeley.edu/general/technical-a-miscellaneous-documents-and-materials

#4 Use CCTV to determine equivalent power needed for reading.

Example: Newsprint read fluently on CCTV with 12X EM, sitting 50 cm from screen. Need ER for SM \( \geq 8 \)
• Select SM from your labeled magnifiers, with ER \( \geq 8 \). Some candidates:

<table>
<thead>
<tr>
<th>Illuminated Stand Magnifiers</th>
<th>Eq. Power (D)</th>
<th>SM to Image distance (cm)</th>
<th>Lens to eye needed for 3.00 add (cm)</th>
<th>ER</th>
<th>Lens (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak 2023 15X</td>
<td>46</td>
<td>16</td>
<td>17</td>
<td>8.4</td>
<td>18</td>
</tr>
<tr>
<td>COIL 6329 14.7X</td>
<td>52</td>
<td>15</td>
<td>18</td>
<td>8.9</td>
<td>28</td>
</tr>
<tr>
<td>Eschenbach 1551 7X/28D</td>
<td>27</td>
<td>31</td>
<td>2</td>
<td>9.6</td>
<td>35</td>
</tr>
<tr>
<td>Schweizer 162 BK</td>
<td>26</td>
<td>28</td>
<td>5</td>
<td>8.3</td>
<td>27</td>
</tr>
</tbody>
</table>

#4 Use CCTV to determine equivalent power needed for reading.

Stand magnifier used at optimal and sub-optimal eye-SM distances

60 = eye to lens distance in mm for image to be 400 mm from eye for 2.5 add
• Eschenbach data: lens to image = 340 mm

#5 Aim for sufficient reading reserve.
• Don’t stop at print size patient desires to read.
• Target at least 0.3 log unit smaller on high contrast acuity chart
  – 3 lines lower on a logMAR chart
  (Represents 50% the goal print size).

#5 Aim for sufficient reading reserve.
Minimum acuity reserves

<table>
<thead>
<tr>
<th>Reading performance w/ magnification</th>
<th>Minimum acuity reserve</th>
<th>Required threshold size to read 1M</th>
<th>Required threshold size to read 2M (large print)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot</td>
<td>1.3:1 (1 line)</td>
<td>0.8 M</td>
<td>1.6 M</td>
</tr>
<tr>
<td>Fluent</td>
<td>2:1 (3 lines)</td>
<td>0.5 M</td>
<td>1.0 M</td>
</tr>
<tr>
<td>Maximum or near maximum</td>
<td>3:1 (5 lines)</td>
<td>0.3 M</td>
<td>0.6 M</td>
</tr>
</tbody>
</table>


#6 Emphasize good lighting

- LED magnifiers
  - Highly important advancement in usefulness of magnifiers
  - Generally superior than incandescent or halogen illumination
- Well directed light onto the page for spectacle magnification
- LED flashlights
- Caution regarding reflections from overhead lights off magnifier surface

#7 Consider recommending electronic e-readers

<table>
<thead>
<tr>
<th>Device</th>
<th>Screen size (&quot; diag)</th>
<th>Light source</th>
<th>Wt (oz)</th>
<th>Recharge time (hr)</th>
<th># of file formats</th>
<th># of fonts</th>
<th># of font sizes</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindle</td>
<td>6</td>
<td>External &amp;/or self Front Ill.</td>
<td>7.8</td>
<td>4.5</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>N</td>
</tr>
<tr>
<td>Paperwhite 3G</td>
<td>8 Back-Ill.</td>
<td>10.9</td>
<td>2</td>
<td>9</td>
<td>6</td>
<td>16</td>
<td>y</td>
<td></td>
</tr>
<tr>
<td>iPad Mini</td>
<td>8 Back-Ill.</td>
<td>13.9</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>16</td>
<td>y</td>
<td></td>
</tr>
<tr>
<td>Kindle Fire HD</td>
<td>7, 9 Back-Ill.</td>
<td>13.1</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>16</td>
<td>y</td>
<td></td>
</tr>
<tr>
<td>Nook HD</td>
<td>7</td>
<td>Back-Ill.</td>
<td>13.1</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>16</td>
<td>y</td>
</tr>
</tbody>
</table>

Resources for e-readers

- See Calibre (http://calibre-ebook.com/) to change file formats, customized fonts, font sizes, etc
- www.mobileread.com - helpful forum on e-readers
- Free Kindle reading apps for most devices — Search "free Kindle reading apps"
- Web sites to check combinations of font/background colors — http://www.pagetutor.com/colorpicker/index.html
  - http://bcn.boulder.co.us/community/tools/colors/sscsgrn.htm
- Stands for tablets: https://docs.google.com/document/d/1QLQaT7jA9Mmz1zY130qK5KxW3fHmAA1T9YVk/edit?pli=1

#8 Discuss computer accessibility options

- Changing font size on web site
  - Examples: Windows Explorer – Use Control (+) to magnify, Control (-) to minify
  - Mac – Use Command (+) to magnify, Command (-) to minify
- Changing font size in a program
  - Check program Home menu for Change Font size or equivalent
  - Zoom feature – some programs have zoom bar, often in the View menu
- Screen magnifier options
- Accessibility Choices
  - For screen magnifier, screen resolution, color contrast settings
  - Windows XP: Accessibility Options (Control Panel)
  - Windows 7, Vista: Ease of Access Center (Control Panel)
  - Mac OS X 10.4 & later: Universal Access (Settings menu)
- Screen magnifying software
#9 Be aware of multifocal add/ hand magnifier (HM) power interaction

- Maximum $F_{eq}$ when magnifier against add (zero separation)
- $F_{eq}$ decreases by “add” worth of power for each unit increase in separation ($t$) of add and HM
  - Where one unit is a focal length of the magnifier.
- Example: +10 D hand magnifier (focal length = 10 cm) with +2.00 add.
  - With magnifier against add, $t = 0$, $F_{eq} = +12$ D
  - With magnifier held 40 cm from add, $t = 4$ focal lengths $F_{eq} = +8.00$ D, much less than the magnifier alone
  - Pt is better to use no add with the magnifier, or a stronger magnifier than otherwise expected may be needed.

$HM$ at add

- Maximum $F_{eq} = F_M + F_A$
- $HM$ at 1 focal length of HM from add $F_{eq} = (F_M + F_A)$
- $HM$ at 2 focal lengths of HM from add $F_{eq} = F_M - F_A$
- $HM$ at 4 focal lengths of HM from add $F_{eq} = F_M - 3F_A$

#10 Consider Galilean telescope (TS) for seniors

- Proper placement of patient entrance pupil in alignment with TS is challenging for many seniors.
- Exit pupil for Galilean TS is inside TS, so patient’s entrance pupil need not be as accurately placed as with Keplerian TS.

#11 Recognize patients who may benefit from using a bar magnifier.

- Magnification in one direction only.
- Magnification = index of refraction of magnifier
  - Index for all magnifiers close to 1.5, so magnification is approximately 1.5X
  - Despite the physical size of the magnifier, magnifications are virtually the same.
- Plane of image seen through magnifier close to object plane, so easy to focus back and forth between magnified and unmagnified images.
- Potentially useful for patient with island of vision
  - Spherical magnification pushes magnified image out of island of vision.
  - Bar magnifier maintains same visual span horizontally while magnifying vertically.

#10 Consider Galilean TS for seniors.

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#11 Recognize patients who may benefit from using a bar magnifier.

10 yo CF, long history of Stargardt’s

- CC: Trouble reading large print, using combination of reading glasses & Illuminated Ott Light Magnifier
  - Would like stronger reading glasses to replace this combination - too cumbersome and print difficult to read
  - Content to continue reading large print. Size = ? 2 M
- VA with current glasses
  1) Bilocal
    RT 5 ft/125
    LT 5 ft/40
    - VA best corrected 6 mo earlier with same glasses:
      RT 20/400 (PH 20/200)
      LT 15 ft/200
      Eccentric viewing both eyes
  2) Near only glasses
    LT (power = +2.50 add) 0.23/2.0/MRD
    Rtn: RT 1 D less minus (5 ft/80)
    LT no change (5 ft/40)
Effect of increasing magnification 1.5X overall vs 1.5X vertically on visual span

Original visual span: 8 letters
Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the ...

Magnify 1.5X overall - cuts visual span to 5 letters

Magnify 1.5X vertically only - maintains 8 letter visual span

Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the ...

#11 Recognize patients who may benefit from a bar magnifier.

Cylindrical magnifiers

- Curvature in one principal meridian only
  - Magnification in curved meridian only
    - Characters enlarged
- Zero curvature in the other principal meridian
  - Zero magnification horizontally
  - Therefore more print within the field of view

General assumptions about cylindrical magnifiers

- Object plane is at center of curvature, C, of the cylinder
- Therefore image plane is the same as the object plane

\[
\begin{align*}
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
\end{align*}
\]

If we assume:

- \( n = 1.5 \) = index of refraction of plastic magnifier
- \( n' = 1 \) (for air surrounding the magnifier)
- Object plane is at center of curvature of cylinder:
  - \( L' = L = F \)

\[
\begin{align*}
n' & = \frac{n}{1 - \frac{n}{n'}} \\
F & = \frac{1}{r} \\
r & = \frac{1}{F} \\
\end{align*}
\]

\[
\begin{align*}
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
1 + \frac{1}{f} & = \frac{1}{1.5} + \frac{1}{r} \\
\end{align*}
\]

#11 Recognize patients who may benefit from a bar magnifier.

Thank you!