Prescribing for anisometropia and aniseikonia

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Disclosure Statement
• Nothing to disclose

Origin of anisometropia

• Axial
• Refractive
• Iatrogenic
  • Retina
    • Epiretinal membrane
    • Vitrectomy
    • Scleral buckle

Approaches to patient Rx

• Axial ametropia
  • Classical thought: spectacles.
    • Knapp’s law
  • Current view: treatments closer to the eye
    • Contact lenses
    • LASIK
• Refractive ametropia
  • Overall vs meridional
  • Consider contact lenses, LASIK first
• Iatrogenic
  • ?

Aniseikonic Effects from Anisometropia

• Aniseikonia
  • Overall
  • Meridional
  • Irregular
    • Irregular astigmatism
    • Epiretinal membrane
    • Vitrectomy

Solutions to aniseikonia

• Use variables that affect spectacle magnification (SM)

\[ SM = \left( \frac{1}{1 - \frac{t}{F_1}} \right) \left( \frac{1}{1 - h(BVP)} \right) \]

- t = center thickness
- n = index
- \( F_1 \) = front surface power
- h = vertex dist +3 mm
- BVP = back vertex power

All + for both plus & minus lenses

To increase SM for plus or minus lenses:

\[ SM \approx hF_v + \frac{t}{n} \]

• Steepen base curve for + or -
• Increase t for + or -
• Vertex dist:
  Plus: ↑ VD, minus: ↓ VD
• Power modification (BVP): ↑ (+) BVP, ↓ (-) BVP
• Index of refraction has little effect on SM.
Solution 1: Modify lenses to reduce known or anticipated spectacle magnification

- ↓ vertex distance as much as possible.
- Change BVP to ↓ anisometropia, intentionally compromising clarity for ↑ comfort.
  - Modify sphere of one or both lenses.
  - Modify cylinder power (usually reducing it), with or without maintaining spherical equivalent.
  - Modify axes to make them more parallel.
  - Just because a lens gives a clearer image does not guarantee it will be more comfortable than a lens that produces a blurred image.

Case example

- EP 67 yo wm
- YAG capsulotomy OD 2003. Subsequent glasses cause spatial distortion. Has had several pairs of glasses:

Written Rx’s presented by patient

- Rx #1: OD +0.25 -0.75 x 115
  OS +0.25 -0.75 x 056 / 2.50 add OU
- Rx #2: OD -1.00 x 115
  OS +0.50 -1.25 x 045 / 2.50 add OU
- Rx #3: OD -1.00 x 116
  OS +0.50 -1.25 x 035 / 2.50 add OU

- One Dr. had never heard of this kind of problem, one thought he had heard about it but had no idea what to do about it, and the third had heard of it but had no idea what to do about it.

Refraction: OD -0.75 x 111 (20/15)
OS +0.75 -1.25 x 061 (20/15-2)

Remember leaf room effects??:

- Meridional magnifiers: OD in 045, OS in 135

Meridional magnifiers: OD in 135
OS in 045

Ogle, K. Researches in binocular vision
Options:  

OD  Pl -0.75 x 111  
OS  +0.75 -1.25 x 061  

• Prescribe spheres only  
• Reduce cylinder power  
• Make axes more parallel and recheck cyl power at new axes  
• Bitoric lenses

Decision:  Modify axes

• Ref:  OD  Plano -0.75 x 111  
OS  +0.75 -1.25 x 061  

• Modification:  
  OD  +0.25 -0.75 x 100  
  OS  +0.75 -1.25 x 080  
  +2.50 add OU

• Results……

8 yr old, no vision complaints

• RT  +4.00 DS  (20/25)  
LT  +0.50 DS  (20/20)  

• What to prescribe?  
• Equal BC and CT?  
• Aspheric RT

Solution 1: Modify lenses to reduce known or anticipated spectacle magnification

• Modify base curves and center thicknesses
  - Equal BCs and CTs work best on plus lenses
  - Not useful on minus lenses.  
  - CTs already equal.  
  - Making BC steeper increases vertex, neutralizing gain from BC.

Base curve selection chart
OD +4.00 DS
OS +0.50 DS

Spherical Corrected Curves (BC) OU
Normal center thicknesses (CT)

<table>
<thead>
<tr>
<th></th>
<th>BC (D)</th>
<th>CT (mm)</th>
<th>% Spec Mag</th>
<th>ΔSM%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt</td>
<td>10.25</td>
<td>4.2</td>
<td>9.3</td>
<td>7.8</td>
</tr>
<tr>
<td>Lt</td>
<td>6.25</td>
<td>2.0</td>
<td>1.5</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Rt Aspheric BC, LT Sph BC
Equal CT

<table>
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<td>5.2</td>
</tr>
<tr>
<td>Lt</td>
<td>6.25</td>
<td>3.6</td>
<td>2.3</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Calculations in table assume A=46, no decentration, n=1.50, for simplicity of data available on aspherics, though PC would normally be considered for safety.

Solution 2: Design iseikonic lenses

- Measure or estimate aniseikonia
  - Aniseikonia Inspector software
  - New Aniseikonia Test (Awaya)
  - Estimate: 1% per diopter of anisometropia in spectacle plane
- Design lenses to make SM more equal
  - Manipulate BC, t, n, h more rigorously.
  - Use a spread sheet or the output from Aniseikonia Inspector.

Measuring aniseikonia

Red-Green software
Aniseikonia Inspector

- 73 yo male
- CC:
  - Diplopia w/ current post-op glasses
  - No diplopia sc
- Med Hx
  - Quadruple bypass, stent
  - Bell’s palsy, left side, 2000
  - Lt hand amputated
  - Insulin dependent DM
- Oc. Hx
  - RT eye, unsuccessful cataract surgery elsewhere
    01/06/09
  - LT eye: cataract

Current glasses

- Single vision distance
  RT +2.25 -2.50 x 180 (20/30⁻¹)
  LT -2.62 -2.00 x 151 (20/30⁻²)
- Single vision near
  RT +4.12 -2.50 x 179
  LT -0.25 -2.00 x 152

Impressions

RT +2.25 -2.50 x 180
LT -2.62 -2.00 x 151

- 2 post-op refractive issues
  - Hyperopic (likely unintended)
  - Significant WTR astigmatism
- Pt not bothered by cataract OS
- Pt not interested in CLs (has only 1 hand)
Options (according to surgeon)

- Do nothing.
- Piggyback IOL
  - Would address sphere only
  - Toric IOL in sulcus not good option due to lack of rotational stability
- IOL exchange
  - Risky: current IOL well “shrink-wrapped” in bag

Options (continued)

- LASIK not recommended (per corneal surgeon)
  - Hyperopic correction requires large ablation zone with high risk of regression
  - Increased complication risk with DM
- Cataract surgery OS
  - Target: Intentional hyperopic spherical equivalent

OR...

- “First kindly ask Bill Brown to see patient for aniseikonic eyeglass correction to see if we can provide non-surgical option that is tolerable.”

Refraction (wlb)

OD  +2.25 -2.50 X 004  (20/25-1)
OS  -2.75 -2.00 X 152  (20/25+1)

Size Lenses

- Magnification without focal power
- L eye:  +3% OA / +3% X 070
  - gave significant relief over distance glasses
Iseikonic glasses Rx for distance glasses (SV) (Epic Labs, Waite Park, MN)

OD  -0.25 +2.50 X 094 (bitoric)
OS  -4.75 +2.00 X 062 (bitoric)

Material:
R  1.56 plastic
L  1.56 plastic

Base curves:
R  3.00 @ 004 / 9.00 @ 094
L  12.00 @152 / 6.00 @ 062

Center thick:
R  3.5 mm
L  5.0 mm

Vertex dist:
R  12 mm
L  9 mm

Bevel as close to front surface as possible on left lens

After picking them up: "On a scale of 1-10, I rate them 7.5…, but my old glasses were a -1."

Adjusted vertex distance Lt eye

Follow-up

• Patient very pleased with improved visual comfort with new glasses despite unusual appearance
  ✓ rates them as "7.25 out of 10, down from 7.5" because he must turn his head to see most clearly
  ✓ No diplopia
• Single vision iseikonic near glasses now on order

<table>
<thead>
<tr>
<th>BC</th>
<th>n</th>
<th>CT</th>
<th>VD</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD</td>
<td>4.50 @ 004 / 7.25 @ 94</td>
<td>1.56</td>
<td>5.5</td>
</tr>
<tr>
<td>OS</td>
<td>12.00 @152 / 6.00 @ 062</td>
<td>1.56</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Place bevel OS as close to front as possible.

Disadvantages to bitoric lenses

• Cosmetic appearance
• Cost
• No multifocals

Prism Induced by Anisometropia

• Horizontal
• Vertical
  ✓ Prentice’s rule
  ✓ Compensated in single vision by keeping eyes close to OCs
  ✓ Trouble comes with multifocal lenses

Prism adaptation

• Adaptation to vertical prism
  ✓ Tendency for vertical phoria to revert to its magnitude prior to induced prism
  ✓ Variable among patients
    • Adaptation takes few minutes to several hours
    • Complete or incomplete
  ✓ Many adapt to induced prism from anisometropia & don’t need prism
Prism NON-adaptation

- Symptomatic and need prism
- Slab off (BU prism)
- Reverse slab off (BD prism)
  - Measure near vertical phoria at reading level.
  - Undercorrect by at least 1-2Δ, generally
  - No less than 2Δ:
    - Line becomes blurry, difficult to manufacture

Measuring slab off prism

*Peters lens clock (LC) technique*

- Slab off (Δ) = LCA - LCB
- LCA = lens clock reading straddling slab off line, pins vertical, peripheral to seg
- LCB = lens clock reading, pins vertical in the distance portion of the lens
- Doesn’t work well for progressive addition lenses where surface power is changing on the front surface of the lens


*Lensometer technique*

- Place lens on lens stop, centered on slab off line, away from segment
- 2 images seen
  - Slab off (Δ) = Difference in displacement of 2 images
  - Image displaced downward with BU slaboff, upward with BD reverse slaboff


Case Example

- JLW, 49 yo wf
- CC: blurred, uncomfortable reading vision with new bifocals.
- Rx: OD -2.00 -1.75 x 001 / +2.25 add
  OS -6.00 DS / +2.25 add
- VA cc: Distance: 20/20+ OD, OS
  Near: .40/.4 OD, OS

Optical crosses

```
  OD  -2.00 -1.75 x 001 / +2.25 add
  OS  -6.00 DS / +2.25 add

  091 001
  OD  OS
  -2.00 -6.00

  -3.75 ~ Net -2.25 extra minus in vertical OS
```

(Images and diagrams are not included in the text representation.)
Prism adaptation

- Adaptation to vertical prism1,2
  - Tendency for vertical phoria to revert to its magnitude prior to induced prism
  - Variable among patients
    - Few minutes to several hours
    - Complete or incomplete
  - Many will adapt to induced prism from anisometropia & don’t need prism
  - Others do not adapt and are symptomatic
    - Need prism


OS: -6.00 DS / +2.25 add / 2Δ slab off

Prentice’s rule: \( P = d F \)
\[ P = 0.1 \text{ cm} \times (2.25) = 2.25^\Delta \text{ BDOS} \]

To compensate:
- 2Δ BUOS in the reading part of the lens
- 2Δ slab off OS or 2Δ reverse slab off OD

Thank you!

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