Astigmatism correction in cataract surgery: A work in progress...

9 things you should know

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1. Threshold for correction:

- Monofocal IOL:
  > 0.50-0.75 (depending on needs)

- Multifocal IOL
  > < 0.50

Financial disclosure:

AMO
Alcon
Clarity i-Optics
Ivantis
PerfectLens
PowerVision
Revision Optics
TrueVision
Ziemer


Figure 1. Effect of astigmatism with Restor +3 add

Astigmatism:

- 0 D = 20/20
- 0.5 D = 20/30

2. Figure out your own results

1. Optimize your lens constants
   - Patients will not see the benefit if the sphere is off

2. Calculate your surgically induced astigmatism
   - (But don’t fully trust it.....)
   - Likely minimal with 2.2-2.4-mm incision

3. Look at at least 3 data points

- IOLMaster or Lenstar: for power
- Topography: for alignment
- Glasses (yes, glasses):
  - Looking for less WTR or more ATR
  - If discrepancies in first two, remeasure—or punt!
We aren't as good as we think we are…
2 measurements one week apart*

4. Factor in posterior corneal astigmatism
   - Contributes ATR refractive astigmatism

What is the curvature of the anterior and posterior corneas?
   - Anterior: 51% are steep vertically
   - Posterior: 87% steep vertically!

What is the effect of the posterior cornea being steep vertically?
   - Creates net plus power along the horizontal meridian
   - Therefore creates ATR ocular astigmatism

How much ATR astigmatism does the posterior cornea induce?

Galilei
Combined Placido-disk and dual-Scheimpflug corneal analyzer

5. Another factor: drift with age
   - Target: small amount of WTR astigmatism to account for the ATR shift with age
     - Averages 3/8 D over 10 years
     - But clearly variable

6. Yet another factor....
   - IOL power and ACD determine effective toricity
     - Deeper AC and lower IOL power: less toric effect
     - Shallower ACD and higher IOL power: more
   - At extremes: Up to 0.5 D in each direction!

7. Picking procedures
   - Relating incision for up to 1.00-1.25 D
   - Toric up to 4 D
     - >4 D: I do toric first and defer relaxing incisions
       - May not be needed & likely a different meridian
       - If a quandary, DO nothing
So how do I decide which toric IOL?

- Company nomograms:
  - Don’t take into account:
    - Posterior cornea
    - ACD/IOL power
    - Always aim to undercorrect
  - Will leave many with residual ATR

Other formulas:

- Holladay Consultant
  - Ignores posterior cornea
- Barrett Toric Calculator: www.ascrs.org
  - Excellent but does not leave patients WTR
- Baylor nomogram
  - Ignores ACD/IOL power but no added data entry

Key issue after ablative surgery:

*This relationship is lost!*

- So we need to be able to measure both the front and the back
- Adds to the existing complexity of interpreting the amount of anterior corneal astigmatism
  - More difficult in post-refractive surgery corneas

Baylor nomogram & other formulas

- Placeholders awaiting more accurate posterior corneal measurements
Case 1: Reduce astigmatism

- Pre-op Lenstar: 1.17D @ 99°
- Add SIA of 0.3D at 125°: 1.38D @ 104°
- Intrastromal incisions: 2 x 45° @ 104°
- Post-op Lenstar: 0.51D @ 83°
- Post-op MR: +0.25 D sph
Case 2: Prevent astigmatism increase

- Pre-op Lenstar: 0.73D@143°
- Add SIA of 0.3D@125°: 0.99D@138°
- Intrastromal incisions: 2 x 35°@128°
- Post-op Lenstar: 0.20D@118°
- Post-op MR: plano

Complications
- 3 eyes overcorrected (flipped axis by > 0.5 D)
- Some large undercorrections...
- There were no other complications

9. Align, align, align
- 10 degrees = 34% error
- 30 degrees = 100% error
- AND creates astigmatism at a new meridian
Effect of misalignment
- Effectiveness of cylinder correction decreases \( \approx 3.3\% \) per each degree of rotation error\(^2\)

Manual marking
- Patient sitting up
- Marks made at 3:00 and 9:00
- Patient repositioned and mark misalignment noted

So how should we mark eyes?
- Landmarks
- Freehand
- Special marker
- High tech option

Mean error \( \approx 4 \) degrees \( \pm 1.5 \) degrees

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High-tech options
- Alcon Verion
- Zeiss Callisto
- TrueVision 3D
- Our data: error =
  - 2.96\(^2\) for automated
  - 2.88\(^2\) for obsessive-compulsive manual marking!

Should we pay for the high-tech option?
- Likely to prove optimal
- Minimizes a key variable...but high cost also
Intraoperative measurement

- Wavetec ORA system
- Clarity Holos

Thank you for your attention