TORIC MONOFOCAL AND MULTIFOCAL IOLs

TIPS AND TRICKS
Expected Standards in Cataract Outcomes

- UCVA
- Quality of vision
- Immediate restoration
- Minimal or no spectacle dependence

We need to achieve reliable refractive outcomes in astigmatism correction.
Approx. 15 - 20% of Cataract patients have 1.5 D or more of keratometric astigmatism or refractive cylinder before cataract surgery.

Auckland Cataract study: the mean refractive cylinder was 1.2D

| Coherence of UCVA and astigmatism at the eye w/o accommodation |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| UCVA                        | 1.0             | 0.8             | 0.5             | 0.25            | 0.16            | 0.08            |
| Astigmatism                 | ±0 D            | ±0.5D           | ±1.0D           | ±2.0D           | ±3.0D           | ±4.0D           |

Ametropia in Dioptres.

Sources: Viestenz et al (2007); Hoffer (1980); Riley et al (2001)
Astigmatism treatment Options

- Positioning and enlarging the Incision.
- OCCI, LRI, AK.
- Biooptics.
- Toric IOLs--------give the most predictable results.
- Cornea and TIOL together focus both meridians at the retina.
- TIOL compensates the different powers of the meridians of the Cornea.
<table>
<thead>
<tr>
<th>Astigmatism</th>
<th>Astigmatism</th>
<th>No Astigmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>No Cataract</td>
<td>No Cataract</td>
</tr>
</tbody>
</table>
Patient Selection
History and Counseling

- Age-young adults esp. those needing Intermediate Vision.
- Habitual Highway Night Drivers.
- Dry Eye Syndromes viz. Sjogren’s.
- A realistic Picture should be portrayed to the patient.
Patient Selection
Basic Clinical Examination

- **External Examination** - Major Lid Deformities.
- **Slit lamp Examination** - Corneal opacity, Keratoconus, Severe OSD.
- **Fundus Examination** - Maculopathy.
- **IOP measurement** - Uncontrolled Glaucoma esp. with severe field loss.
- **Corneal Topography** - Irregular Astigmatism, Coma etc.
Biometry Techniques

- **Contact**
  - LA & a 10 Mhz probe is placed on the cornea perpendicular to the iris plane.
  - Reading depends on indentation so to minimize error average of 6 readings is taken.

- **Immersion**
  - This is a non contact technique where a water bath is used.
  - Mechanical factor of corneal compression is taken care of.

- **Optical Biometer (IOL Master)**
  - Latest/ most accurate.
Parameters for IOL calculation:

- Axial length
- Anterior chamber depth
- Corneal radii [mm] or keratometer values [D]
  
  **Note:** consider measurement technique and corneal index
  
  (Zeiss n=1.332; Javal n=1.3375)

- SIA - Impact of surgical technique
- Induction of astigmatism!

- Target refraction
Performing a valid biometry to achieve correct data.

- Contact lenses (depending on type) absence from 2 days up to 2 weeks.
- Sicca- after a natural blink.
- Measurement should be done before any other measurement which has an impact on the cornea, e.g. Tonometry, dilatation.
- K’s from corneal topographer being Sim k’s – not preferred.
- Regular optimization of A Constants with ULIB or in IOL Master with our own data.
Performing a valid biometry to achieve correct data - Ultrasound

- **Ant & Post Lens spike**
  - The post lens spike has to be of good gain.

- **2 retinal spikes are a must**
  - The ant spike has to be at right angles to the Hx meridian for your graph to be considered good.
Performing a valid biometry to achieve correct data- IOL Master

Axial length: 1mm difference to the standard is ~3D

**Axial Length**

- Minimum of 5 measurement results within 0.05 mm.
- Adequate SNR to be achieved.
- Analysis of the measurement.

Remeasure Axial length if:

- Axial length diff between both eyes is more than 0.3mm.
- <22 mm
- >25 mm
- It does not corroborate with patients refractive error / Glasses.
- If patient has poor fixation.
Formula performance for outcomes within ±0.50 D of target refraction

Data courtesy of Warren E. Hill, MD, FACS
Performing a valid biometry to achieve correct data.

**Keratometry (IOL Master)**

- It is done before the AL not simultaneously.
- Eye has to be opened during the measurement- marks should not be wholly or partly obscured.
- Measuring mark has to be centered.
- The peripheral marks should have sharp haloes.
Recheck Keratometry

- K < 40D or > 47D.
- < 40D may indicate previous refractive surgery.
- > 47D may indicate Keratoconus.
- K correlates poorly with refraction cylinder.
- Difference in K values between two eyes.
Performing a valid biometry to achieve correct data

**Anterior Chamber Depth**

- Results depend on the position of the patient.
- Patients need to fixate in the light of the slit in case of IOL Master.
- Results have to be consistent.

**Change in ACD**
My SIA is NIL
<table>
<thead>
<tr>
<th>Chart/Case Number</th>
<th>Patient Age</th>
<th>EYE OD/OS</th>
<th>Prior Corneal Surgery?</th>
<th>Location</th>
<th>Description (Automated)</th>
<th>Size (mm)</th>
<th>Type</th>
<th>Steep K</th>
<th>Flat K</th>
<th>Steep Merid</th>
<th>Flat Merid</th>
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<td>44.62</td>
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<td>95</td>
<td>80</td>
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</tbody>
</table>
### Estimated Surgically Induced Astigmatism (SIA)

**Surgeon Name:** User  
**Incision Type:** Clear Cornea, Incision Size Range: 2.2 - 2.2, All Patient Ages

#### OD (Right)

<table>
<thead>
<tr>
<th>Incision Location</th>
<th>Surgically Induced Astigmatism (D)</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal</td>
<td>0.24</td>
<td>28</td>
</tr>
<tr>
<td>Nasal</td>
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<td>0</td>
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<tr>
<td>Superior</td>
<td>0.35</td>
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<tr>
<td>Inferior</td>
<td>0.00</td>
<td>0</td>
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<tr>
<td>Superior Temporal</td>
<td>0.30</td>
<td>10</td>
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<tr>
<td>Inferior Temporal</td>
<td>0.35</td>
<td>9</td>
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<tr>
<td>Overall SIA</td>
<td>0.31</td>
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</table>

#### OS (Left)

<table>
<thead>
<tr>
<th>Incision Location</th>
<th>Surgically Induced Astigmatism (D)</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal</td>
<td>0.27</td>
<td>26</td>
</tr>
<tr>
<td>Nasal</td>
<td>0.00</td>
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<td>Superior</td>
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<tr>
<td>Inferior</td>
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<td>Inferior Temporal</td>
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<tr>
<td>Overall SIA</td>
<td>0.32</td>
<td>46</td>
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</tbody>
</table>

*Printed 3/15/2013 12:11 AM*
Online toric IOL calculator
Z- CALC highly reliable Zeiss algorithm

WWW.IOLMASTER-ONLINE.ZEISS.COM

- **Z CALC™ offers:**
  - Fast calculation
    - Real-time calculation
    - Real-time modification of sphere and cylinder of both eye simultaneously
  - Easy handling
    - Easy-to-use interface
    - Online help for users
  - Reliable refractive outcomes
    - Time-proven, optimized
    - Calculation algorithm
How to use Z CALC™ – Calculation

- On this screen the refraction data can be entered.

Enter in mm so that the default RI is 1.3375

Both eyes can be calculated at the same time to compare the potential post-op results

Enter SIA here

All toric IOLs by ZEISS can be calculated with Z CALC™

Please enter the measured value of the ACD. Always use “Epithelium” if measured with IOLMaster
How to use Z CALC™ – Calculation

The residual sph and cyl is shown

The IOL sph and cyl shown
How to use Z CALC™ – Change in IOL Power with SIA

Shahani, Rajendrasingh Patient ID: 11-11-5/2012

Right (OD)

<table>
<thead>
<tr>
<th>Subjective refraction</th>
<th>S: -4.00 dpt C: -0.75 dpt A: 110°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial length</td>
<td>24.29 mm</td>
</tr>
<tr>
<td>Keratometry / n'</td>
<td>R₁/K₁ 7.88 mm Axis₁ 177°</td>
</tr>
<tr>
<td></td>
<td>R₂/K₂ 7.69 mm Axis₂ 87°</td>
</tr>
<tr>
<td>Anterior chamber depth</td>
<td>3.04 mm</td>
</tr>
<tr>
<td>Incision orientation</td>
<td>0°</td>
</tr>
<tr>
<td>IOL type</td>
<td>AT LISA toric 909M</td>
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</table>

Left (OS)

<table>
<thead>
<tr>
<th>Subjective refraction</th>
<th>S: -6.00 dpt C: -2.50 dpt A: 25°</th>
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<tr>
<td>Axial length</td>
<td>24.83 mm</td>
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<td>Keratometry / n'</td>
<td>R₁/K₁ 7.84 mm Axis₁ 90°</td>
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<td>R₂/K₂ 7.60 mm Axis₂ 93°</td>
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<tr>
<td>Anterior chamber depth</td>
<td>3.09 mm</td>
</tr>
<tr>
<td>Incision orientation</td>
<td>90°</td>
</tr>
<tr>
<td>IOL type</td>
<td>AT LISA toric 909M</td>
</tr>
</tbody>
</table>

Change in IOL Sph and Cyl both
Change in SIA
Z Calc-Interpretation

- The color coded **yellow** and **red** fields indicate an entry is outside the `normal‘ range.
- **Yellow** indicates values slightly beyond the most common parameters – Z CALC will continue to calculate but please verify the patient data.
- **Red** indicates values where Z CALC will not continue to calculate the toric IOL.
- We should always compare the results of both eyes.
- If historical subjective refraction is available, check for plausibility.
The sph equivalent is 16D

The IOL sph power is 15D

Z Calc - Comparison with Biometry

<table>
<thead>
<tr>
<th>OD (right)</th>
<th>OS (left)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1: 34.8 mm (SNR = 245.4)</td>
<td>A1: 34.8 mm (SNR = 245.4)</td>
</tr>
<tr>
<td>R: 7.68 mm/43.60 D @ 87°</td>
<td>R: 7.68 mm/43.60 D @ 87°</td>
</tr>
<tr>
<td>R: 7.68 mm/43.60 D @ 87°</td>
<td>R: 7.68 mm/43.60 D @ 87°</td>
</tr>
<tr>
<td>CYL: -1.00 D @ 177°</td>
<td>CYL: -1.00 D @ 177°</td>
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<tr>
<td>ACD: 3.09 mm</td>
<td>ACD: 3.09 mm</td>
</tr>
<tr>
<td>Refraction: -0.00 D to -0.70 D @ 110°</td>
<td>Refraction: -0.00 D to -0.70 D @ 110°</td>
</tr>
<tr>
<td>Vertex: 12 mm</td>
<td>Vertex: 12 mm</td>
</tr>
</tbody>
</table>

Patient data sheet

<table>
<thead>
<tr>
<th>Right (OD)</th>
<th>Left (OS)</th>
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<tbody>
<tr>
<td>Refraction: -0.00 D to -0.70 D @ 110°</td>
<td>Refraction: -0.00 D to -0.70 D @ 110°</td>
</tr>
<tr>
<td>Vertex: 12 mm</td>
<td>Vertex: 12 mm</td>
</tr>
</tbody>
</table>

Biometry preoperative (precop)
When we get non Toric in Z Calc

- Either LRI or plan change of Incision site viz. Flat Axis.
Difference between Z CALC and the other calculators

**Z-CALC**
- Real calculation of the IOL, independent of Formulas used for A Scan.
- Both eyes can be calculated simultaneously on the same screen, the Surgeon can play with different post op scenarios.

**Other TIOL Calculators**
- Do not calculate the spherical part of the IOL power.
- The Surgeon has to fill in the “Spherical Equivalent” already calculated on Biometry.
  It doesn't take into account the toricity of the cornea but calculates a sphere with only one radius!
- The more astigmatic a cornea is the more inexact is the calculation.
Pre-Operative Marking

- The pre-operative reference marking is applied before anesthesia while the patient is sitting upright with both eyes open.

The instruments necessary for marking are:

- A corneal marker.
- A slit lamp with a grading ring.
- Anatomical Reference points of the eye.
Marking on the slit lamp.
Prior to Cataract Surgery...

Nuijts/Lane Pre-op Toric Reference Marker: AE-2791TBL
Bubble-level for precise alignment
Used temporally

Pre-op Toric Reference Marker: AE-2793D
Lightweight, titanium body
Used temporally

Pre-op Toric Reference Marker, Single-Sided: AE-2793S
Handle position allows even marking with less pressure

Prior to Toric IOL Implantation...

Nuijts/Solomon Toric Axis Marker: AE-2740N
Circular opening for maximum visibility
Used with the Beveled Degree Gauge

Maloney Astigmatism Axis Marker: AE-2741
Laser lines indicate marking pattern
Used with the Beveled Degree Gauge

ASICO Beveled Degree Gauge: AE-1590
Beveled design for maximum visibility under the microscope

Modi Intra-Op Toric Marker: AE-2848
Designed for small eyes
Very thin profile

Intra-Op Toric Axis Marker II: AE-2794
Marker and degree gauge in one
Cutouts for precise alignment
Surgery

Anesthesia
- Topical – preferred.
- Local – the centre of fixation is marked before giving the block.

Marking
- With the patient fixing in the centre of the microscope light both the incision and axis of placement are marked with the circular marker.

Incision
- The incision size for a ZEISS toric IOL implantation is less than 2.0 mm.
- I use a 2.2 mm incision.
Accurate Lens Alignment

**ACCURATE CENTRATION IS CRITICAL**

- Rhexas - 5.5 mm.
- On Insertion the Lens is aligned a few degrees (20°) shy off the marked axis prior to Polishing of the Ant capsule.
- Complete Visco-elastic removal above and below the IOL.
- Markings on IOL are aligned precisely with the axis placement markings.
- In case of parallax concentrate on the proximal 0° mark and the 90° as the distal mark may seem off (due to parallax).
- Patient asked to look into the Microscope light and the center of the lens is tapped. **Remember it is a (Tetrapod) plate Haptic Lens**
- The chamber is sealed, Air may be injected for Tamponade.
Pitfalls

- Associated Ocular Conditions are missed – viz. Corneal pathology.
- Poor K.
- Poor Reference Mark / Head tilt.
- Bent axis marker / Circular marker off the eye center.
- Lens not aligned because of parallax or Viscoelastics.

If all are added - lot of opportunity for error - so minimize all variables.
Astigmatism

Also slightly Undercorrect WTR and Overcorrect ATR as the posterior Corneal Astigmatism is not taken under consideration.
Pitfalls - Inadequate Visco elastic Removal

- Rotation about 1° causes correction of approx. 3.3% of pre op astigmatism.

- Rotation about 30° will not correct astigmatism - simply axial rotation.

- Rotation above 30° may increases astigmatism.
# Contraindication

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<th>Pre op</th>
<th>Intra op</th>
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<td>- Keratoconus if no C3R</td>
<td>- PC rupture</td>
</tr>
<tr>
<td>- Amblyopia</td>
<td>- Zonular Damage</td>
</tr>
<tr>
<td>- Unstable Corneal Astigmatism</td>
<td>- If Primary PCC is planned</td>
</tr>
<tr>
<td>- Irregular Astigmatism</td>
<td>- If 360° overlap of rhexis margin is not there.</td>
</tr>
</tbody>
</table>
Surgical Technique
Post Operative management

Especially to fine tune and customize the measurements

- Post-operative checks are performed one day, one week and four weeks after surgery.
- A subjective refraction for distance and near is obtained (an autorefractor is not recommended).
- A topography is performed.
Conclusion

Is there anything more wonderful than seeing life – effortlessly?

- 80% of the information we receive comes in through our eyes.
- Sight is by far our most important sense – to see is freedom; to see is independence; to see is to live life to the fullest.
- Patients are individuals and the solution unique.
- The need of the day is to use all our Tricks and Tips to become Phaco Refractive Surgeons.