Intraoperative techniques for managing astigmatism

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Effects of misalignment

- 4°: ↓ 14%
- 10°: ↓ 34%
- 30°: No △
  - Axis shifts!
- If > 30°,
  ↑ astigmatism!

Pre-op marking

- Goal is to provide reference marks to help with alignment intra-operatively
- Marking done with patient upright in pre-op area to minimize cyclorotation effects
Pre-op Marking

- Wetfield Osher ThermoDot Marker
  - Bipolar mark, ink-free
- Akahoshi electronic toric marker
  - Beeps when aligned horizontally

Intraoperative Marking

VERION™ Reference Unit and Digital Marker
- Imaging: keratometry, pupillometry, reference image (scleral vessels, limbus, iris features)
- Surgical planning: incision & implantation axis planning customization
- Guide: uses patient information and images for tracking overlay; accounts for cyclorotation, eliminates need for pre-op marking

Limbal Relaxing Incisions

Pros
- Inexpensive
- Easy to perform
- Minimal instrumentation
- Can be done at time of cataract surgery
- No impact on cataract healing
- Can be repeated

Cons
- Must have topographer and be able to interpret topography
- May induce irregular astigmatism when greater than 1.5 D
- Risk of perforation
- Less precise than laser vision correction or toric IOLs
Nomograms

- Gills
- Koch
- Lindstrom
- Wallace
- Thorton
- Nichamin
- Casebeer
- Donnenfeld

Where Do You Place Your LRI During Cataract Surgery?

- Refractive axis
- Keratometric axis
- Topographic axis

Calculating Incision Induced Astigmatism

- First step: Calculate surgically induced cylinder from incision

Calculating LRI Incisions

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**Getting Started with LRI’s**

**Step 1:** Start in OR with a peribulbar block  
**Step 2:** Pre-set 0.6 mm depth diamond blade  
**Step 3:** Limbal relaxing incision ½ mm in from limbus.  
**Step 4:** Fixate globe with .12 forceps 180 degrees away from incision.

**Step 5:** Use upside down topography and center incisions on steep axis (+cylinder).  
**Step 6:** Set diamond knife perpendicular in cornea, hold like a dart, allow blade to seat fully then pull slowly towards surgeon.

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**Limbal Relaxing Incisions**

**Challenges-Limbal Relaxing Incisions**

- Variable and unpredictable treatment and response  
  - Imprecise depth, length, angulation and position of incision  
  - “LRIs are an art form not a science”
**Femtosecond Laser Arc Incisions are Adjustable**

- Full effect of the incision is not achieved until the incision is manually opened
  - Intraoperatively or postop
- Titrate response to laser by adjusting
  - Line separation
  - Spot separation
  - Energy
  - Angulation of incision

**Intrastromal Ablations for Astigmatism**

- Less effective than full thickness incisions
  - Smaller optical zones
- Bowman’s membrane remains intact
  - Less pain
  - Reduced loss of corneal sensation
  - Less dry eye
  - Greater wound stability
  - No need for antibiotics

**Starting Laser Nomogram**

<table>
<thead>
<tr>
<th>Donnenfeld Nomogram for Limbal Relaxing Incisions</th>
<th>Nomogram for 9 mm Arc Incisions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0.50 D</strong></td>
<td>1 Incision, 1 ½ Clock Hours (45 Deg. Each)</td>
</tr>
<tr>
<td><strong>0.75 D</strong></td>
<td>2 Incisions, 1 Clock Hour (30 Deg. Each)</td>
</tr>
<tr>
<td><strong>1.50 D</strong></td>
<td>2 Incisions, 2 Clock Hours (60 Deg. Each)</td>
</tr>
<tr>
<td><strong>3.00 D</strong></td>
<td>2 Incision, 3 Clock Hours (90 Deg. Each)</td>
</tr>
</tbody>
</table>

*Use 5 degrees more for against-the-rule-astigmatism
*Use 5 degrees more for younger patients
*Use 5 degrees less for older patients

85% Depth

**LRIs vs Toric IOLs**

**LRI**

- Inexpensive
- Can be combined with advantages of femtosecond laser cataract surgery
- Best for 1 D or less cylinder

**Toric IOLs**

- Does not induce irregular astigmatism
- Can be used in thin mildly irregular corneas
- Does not induce dry eye
- Best for 1.5 D or more cylinder
Conclusions

- LRIs, arcuate incisions, and toric IOLs are now playing an increasingly important role in refractive cataract surgery.
- Femtosecond arcuate incisions may now be made at the time of cataract surgery with increased precision and safety.
- Intrastromal arcuate incisions will play an important role in astigmatism management.
- Toric IOLs are best for higher levels of cylinder.