Intraoperative techniques for managing astigmatism

Eric Donnenfeld, M.D.
Ophthalmic Consultants of Long Island
Clinical Professor of Ophthalmology NYU
Trustee Dartmouth Medical School
President ASCRS

Effects of misalignment

- 4°: ↓ 14%
- 10°: ↓ 34%
- 30°: No Δ
  - 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

Disclosure

I am a consultant for:
- Acufocus
- Allergan
- Alcon
- AMO
- Aquesys
- Bausch & Lomb
- CRST
- Elenza
- Glaukos
- Kala
- Lacrepipen
- Lensx
- Mati Pharmaceuticals
- Merck
- Mimetogen
- Novabay
- Ocuhub
- Odyssey
- Pfizer
- PRN
- QLT
- RPS
- Sarcode
- Strathspey Crown
- Tearlab
- TearScience
- TLC Laser Centers
- TrueVision
- Wavetec

Pre-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
**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 \( \frac{1}{2} \) 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.

**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

Intraoperatively or postop

Titrate response to laser by adjusting

Line separation

Spot separation

Energy

Angulation of incision

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>0.50 D 1 Incision, 1 ½ Clock Hours (45 Deg. Each)</td>
<td>1 Incision, 1 Clock Hours (30 Deg. Each)</td>
</tr>
<tr>
<td>0.75 D 2 Incisions, 1 Clock Hour (30 Deg. Each)</td>
<td>2 Incisions, 2/3 Clock Hour (20 Deg. Each)</td>
</tr>
<tr>
<td>1.50 D 2 Incisions, 2 Clock Hours (60 Deg. Each)</td>
<td>2 Incisions, 1 1/3 Clock Hours (40 Deg. Each)</td>
</tr>
<tr>
<td>3.00 D 2 Incision, 3 Clock Hours (90 Deg. Each)</td>
<td>2 Incision, 2 Clock Hours (60 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

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

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