YAG Capsulotomy
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Disclosure statement
Nothing to disclose

Course Outline
- Brief overview of laser tissue interactions
- Posterior capsular opacification (PCO)
- Overview of YAG laser
- Capsulotomy indications/contraindications
- Preoperative preparation
- Capsulotomy techniques
- Postoperative management
- Risks and complications

Mrs. B
- Chief complaint “blurry vision”
- 20/50 BCVA OD, OS
- Posterior segment unremarkable

Mrs. B
- “Why did I have this complication? Did the surgeon mess up?”
- “Why did you send me to a quack surgeon?”
Mrs. B

- “Is this procedure safe? What's the risk of complication? Can I go blind?”

Mrs. B

- “Is my insurance going to cover this?”
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- “What if I decide to wait? Is there harm in waiting? Does the procedure become more difficult or risky?”

Laser Characteristics

- Certain laser characteristics make them useful medically
  - Single Wavelength
  - Low divergence
    - Energized
    - Focused
    - Controlled

Laser Variables that Influence Interactions

- Wavelength
- Spot size
- Pulse duration

- Laser variables interact to determine characteristics of energy delivered to the eye

Laser Variables that Influence Interactions

- Wavelength
  - Determines which pigment/tissue will absorb energy
  - In general, longer wavelengths penetrate deeper
    - Ultraviolet: cornea (excimer 193um)
    - Green/yellow/red lasers: retina
Laser Variables that Influence Interactions

- Wavelength
  - Infrared (longer wavelengths)
  - Photodisruption
  - Nd:YAG

- Spot size
  - Smaller spot size has a greater energy density

- Spot size
  - YAG and SLT: fixed spot sizes
  - Laser lens: optional in YAG procedures
    - Tightens the spot size
    - Effectively increases energy density

- Pulse duration
  - Short pulses (.02 - .05sec): photovaporization or photodisruption
  - Longer pulses (.1 - .2 sec): photocoagulation
Transparency and pathology
- Corneal pathology can affect transparency
- Scars, edema, infiltrates make cornea opaque
- Cornea absorbs more laser energy and may cause corneal burn

Pigmentation
- Some lasers are dependent upon pigment for their effect (Argon)
- Some lasers are pigment independent (YAG)

Tissue Variables That Influence Interactions

Specific Laser-Tissue Interactions

- Transparency
- Tissue transparency depends on wavelength
- Healthy ocular media is transparent to 400nm (blue) to 700nm (red)

- Pigment
- Some lasers are dependent upon pigment for their effect (Argon)
- Some lasers are pigment independent (YAG)

- Water Content

- Pathology in the aqueous can also affect transparency
- Cell/flare, hyphema
- Increased absorption of laser energy
- Increased complications
**Photodisruption**

- Pigment independent
- High energy, small spot size, brief pulse duration
  - Extremely high energy density
- 15,000°C increase
- Optical breakdown: laser energy reduces tissue to plasma
- Molecules are stripped of electrons

**Photodisruption**

- Produces small explosion
  - Hydrodynamic waves and acoustic pulses travel back toward the surgeon
  - These shockwaves disrupt tissue
- Therefore, the focal point must be posterior to the target tissue

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**Figure 3-6** Posterior YAG offset

![Figure showing beam positions](image)

- Treatment beam positions at different dial settings
  - MIN, +150, +250
- Aiming beam 1
- Aiming beam 2
- Focal plane

# Note that distances shown reflect measurements in air.

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**Posterior Capsular Opacification**

- **Pathophysiology**
  - Anterior capsulorrhexis in cataract surgery
  - Residual lens epithelial cells proliferate
- **Prevalence**
  - 3-50% 5 years postoperatively
  - Higher in young patients
  - Arises months-years postoperatively

**Posterior Capsular Opacification**

- **Signs**
  - Translucent or opacified film behind IOL
  - Elschnig’s Pearls
  - Vesicles with/without turbid fluid inside
- **Symptoms**
  - Similar to cataract
  - Blur, glare, decreased contrast sensitivity
Nd:YAG Laser
- Developed in early 1980’s
- Photodisruptive laser
  - Pigment independent
  - 1064nm near infrared
- High energy, small spot, brief duration (very concentrated)
  - Localized temperature increase of 15,000°C

Nd:YAG Laser
- Produces explosion and acoustic shockwaves
  - Shockwaves break through tissue
  - Shockwaves are directed back toward the doctor
  - Therefore focus of laser (explosion) must be just posterior to the capsule

Capsulotomy Indications
- PCO must interfere with activities of daily living (ADL) and quality of life
- May be considered if PCO critically interferes with visualization of retina
- Needed earlier in eyes with multifocal IOL
  - Multifocal IOLs cause decreased contrast sensitivity
  - Exacerbated by mild PCO

Capsulotomy Contraindications
- Active uveitis
- Corneal pathology/opacity
- Macular edema
- Retinal disease
  - Consider retinal consult/clearance
Preoperative Exam
- BCVA, glare test, pinhole
- IOP
- Slit lamp
- Dilated fundus exam
- Rule out other causes for decreased vision

Preoperative Preparation
- Note size/shape of undilated pupil
  - Just large enough to avoid glare
- Dilate pupil
- Topical anesthetic
  - Brimonidine or apraclonidine
  - Reduces IOP spike risk

Capsulotomy Techniques
- Laser settings
  - Initial energy ~1mJ
  - Offset: 250-350um posterior
  - Fixed spot size, duration
  - Focus carefully on posterior capsule
    - Avoid IOL and anterior hyaloid face

Capsulotomy Techniques
- Laser lens
  - Magnifies target tissue
  - Stabilizes eye and lids
  - Decreases spot size (concentrates energy)
  - Decreases acoustic propagation into eye
  - Downside: uncomfortable for patient

Capsulotomy Techniques
- Fire initial shot
  - If no tissue response, refocus and repeat
  - If still no response, increase energy by 0.3-0.5mJ
  - Each shot creates small localized break
    - Aim shots such that each break is continuous with the previous one

Capsulotomy Techniques
- Various shape approaches
Capsulotomy Techniques

Capsulotomy and Crystalens

- Capsulotomy may spontaneously enlarge with lens translation
  - Increases risk of IOL dislocation
- Recommendations
  - Maximum 4mm diameter
  - Avoid acute edges
    - Circular or octagonal approach

Capsulotomy and Crystalens

- Z Syndrome
  - Rarely occurs after Crystalens implantation
  - Capsular contraction causes “Z” configuration
  - Capsulotomy may improve or complicate the situation

Postoperative Management

- Immediate postop brimonidine or apraclonidine
- Check IOP in 1 hour
- Prednisolone acetate QID x 1 week
  - Recent literature questions this
  - Postop visits in 1 week and 1 month

Postoperative Management

- Postop visits
  - Acuity
  - IOP
  - Slit lamp
  - Dilate at one month
Capsulotomy techniques

- Techniques are largely based on practitioner preference
- How to determine best practices?

Capsulotomy techniques

- 2011 survey of British ophthalmologists
  - 300 surveyed, 158 replied
- Use of dilating drops, capsulotomy shape/size, use of contact lens, steroid use, follow-up schedule

Capsulotomy techniques

- Dilation
  - 98.5% dilate before capsulotomy
- Size
  - 64% aim for size larger than undilated pupil
- Shape
  - 47% cruciate, 27% circular, 24% combination
- Use of contact lens
  - 88% use one

Capsulotomy techniques

- Topical steroid use
  - 42% use postoperative prophylactic steroids
- Postoperative follow-up
  - 39% see patients for routine postoperative visits
    - Mostly within one month

Risks & Complications

- IOP Spike
  - Most common complication that requires treatment
  - FDA cohort of 213 patients
    - 39% had IOP spike (>5mmHg) 1-6 hrs postop
    - None treated with prophylactic hypotensives
  - Prospective randomized trial (1988)
    - Pre- and postop apraclonidine vs placebo
    - Placebo tended to spike 3 hrs postop
    - Apraclonidine group had lower postop IOP

Risks & Complications

- Iritis
  - Incidence 1-2%
  - Despite low rate, postop steroids are commonly used
    - Prednisolone acetate QID x 1 wk
**Risks & Complications**

- Cystoid macular edema
- Retinal detachment
  - May occur weeks to years after capsulotomy
  - Risk factors: axial myopia, pre-existing vitreoretinal disease, male gender, young age, vitreous prolapse, spontaneous extension of capsulotomy
- IOL displacement
- IOL damage (lens pits)
  - Most common complication in FDA cohort of 2110 patients
  - Visually inconsequential (usually)

**IOL Pits**

- Consider increasing posterior offset

**A note on vitreous prolapse**

- Prolapse of vitreous humor into anterior chamber is possible if capsulotomy done improperly
YAG capsulotomy complications

- How do we minimize complications?
- Does higher energy per pulse cause more complications? What about cumulative energy?

2015 YAG complication study

- 2015 study
- 474 consecutive eyes
- Analyzed factors that led to complications

Conclusion: Total laser energy is an important factor leading to complications
2015 YAG complication study

<table>
<thead>
<tr>
<th>Complication</th>
<th>Incidence</th>
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<tbody>
<tr>
<td>Uveitis</td>
<td>9.9%</td>
</tr>
<tr>
<td>IOP spike</td>
<td>12.6%</td>
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<tr>
<td>IOL pitting</td>
<td>7.8%</td>
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<tr>
<td>Cystoid macular edema</td>
<td>2.9%</td>
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<tr>
<td>Retinal detachment</td>
<td>2.3%</td>
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<table>
<thead>
<tr>
<th>Complication</th>
<th>Mean total energy with complication (mJ)</th>
<th>Mean total energy without complication (mJ)</th>
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</thead>
<tbody>
<tr>
<td>Uveitis</td>
<td>65</td>
<td>42</td>
</tr>
<tr>
<td>IOP spike</td>
<td>76</td>
<td>42</td>
</tr>
<tr>
<td>IOL pitting</td>
<td>62</td>
<td>43</td>
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<tr>
<td>Cystoid macular edema</td>
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<td>42</td>
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<tr>
<td>Retinal detachment</td>
<td>78</td>
<td>43</td>
</tr>
<tr>
<td>Overall average</td>
<td><strong>66</strong></td>
<td><strong>37</strong></td>
</tr>
</tbody>
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2015 YAG complication study

- Retinal detachment: a closer look
- 11 RDs in 474 eyes (2.3%)
- Mean onset 11.7 months post YAG
  - Range 4-15 months
- Risk factors
  - Higher total laser energy
  - Higher axial length
- Recommendation: avoid large capsulotomy in patients with high axial length

2015 YAG complication study

Mean energy level by PCO subtype

- Pearl: 1.8mJ starting energy; 22mJ total
- Fibrous: 2.8mJ starting energy; 65mJ total

Capsulotomy pearls

- Patient education
  - Expect bright flashes of light and “pops” of sound
- Lens glare and obtaining clear image
  - Practice with gonioscopy
- Localized fibrosis
  - “Curve” your treatment to avoid localized dense fibrosis
Maximizing shot efficiency

Billing & Coding
- CPT 66821
- 90-day global period
- $332 per eye ($314 if done in ASC)
  - Be aware of ASC fees
  - Generally separate eyes by 1 week

Video examples

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Questions?

Thank you!

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