Anterior Segment Laser Surgery.

Jorge L. Fernandez Bahamonde. MD.
Procedures.

- Laser Peripheral Iridotomy (LPI)
- Laser Peripheral Iridoplasty.
- Laser Pupilloplasty.
- Laser Trabeculoplasty (LTP).
- Selective Laser Trabeculoplasty (SLT).
- Laser Posterior Capsulotomy.
- Misc.
  - Suture Lysis.
  - Fistula revision.
  - Goniophotocoagulation.
Laser Peripheral Iridotomy.

Indications.

- Primary and secondary pupillary block.
  - Known glaucoma cases.
    - POAG, narrowing (mixed mechanism).
    - Acute Angle Closure.
    - CACG.
  - Secondary angle closure.
- Glaucoma suspects.
- Ciliary block glaucoma.
  - To r/o pupillary block component.
Laser Peripheral Iridotomy.

Contraindications.
- Flat anterior chamber.
  - Proceed with limited iridoplasty?
- Severe intraocular inflammation.
  - Decrease inflammation, go to fellow eye.
- Severe corneal edema.
  - Stabilize condition, go to fellow eye.
Laser Peripheral Iridotomy.

- Pre-op.
  - VA, IOP, SLE exam, including gonioscopy
  - Informed consent.
  - Pilocarpine 2%, Iopidine after pupil is miotic.
  - Wise lens (104 diopters), Abraham (66 diopters).
  - Topical anesthesia.
  - Attendant required.
Laser Peripheral Iridotomy.

Procedure.
- Argon, blue-green.
  - 0.02 Sec.
  - 50 microns.
  - 1500-2000 mW.
  - 20-30 shots.
  - Punch out.
- Nd:YAG.
  - 3.5-4 mJ.
  - Dead center.
Laser Peripheral Iridotomy.

- Post-op.
  - IOP plus 1-2 hrs.
  - Aggressive treatment of IOP spikes (>10 mmHg).
    - Use other meds pre-op. if patient uses iopidine or alphagan.
  - Continue medical therapy.
  - Topical steroids for a few days.
    - Those using PG may get into trouble.
      - Post-op iritis.
Laser Peripheral Iridotomy

Complications.

- IOP spikes, use iopidine.
  - Check IOP post-op always.
- Bleeding (YAG), apply pressure, argon to coagulate?
- Iritis, remember those on PG.
- PI Closure.
- Corneal edema.
- Retinal burns?
- Cataract/Lens rupture.

Laser Peripheral Iridoplasty.

- **Indications.**
  - Consider it as a “temporary procedure”.
  - Plateau iris.
    - After a patent PI.
    - May need further treatment.
  - Narrow angles, before ALT/SLT.
  - Consider a LPI first.
  - Pre-LPI on very shallow A/C.
Laser Peripheral Iridoplasty.

**Pre-op.**
- Identical to LPI.

**Technique.**
- 180° vs. 360°. 15-30 spots.
- Avoid confluent burns (iris necrosis).
- Central lens of argon laser three mirror.
- 0.5 sec/500 microns/200-400 mW.
- As peripheral as possible.
Laser Peripheral Iridoplasty

- Post-op.
  - IOP plus 1-2 hrs.
  - Aggressive treatment of IOP spikes (>10 mmHg).
  - Continue medical therapy.
  - Topical steroids for a few days.
Laser Peripheral Iridoplasty.

Complications:
- IOP spikes.
  - Iopidine.
  - Check IOP.
- Iritis.
  - Beware of Prostaglandins.
- Further angle closure.
- Corneal edema.
Laser Pupilloplasty.

Indications.
- Improve optical axis.
  - Post trauma, inflammation or surgery.
- Angle closure glaucoma.
  - Very narrow A/C.
  - Anterior chamber IOL-pupillary block.

Pre-op.
- Similar to LPI, just avoid pilocarpine.
Laser Pupilloplasty.

 Technique.

 - 0.2-0.5 sec./200-500 microns/250-400 mW.
 - Need your imagination.
 - Use YAG to help with sphincter lysis.
 - Abrahams or Wise lens.

 Complications.

 - Iritis (give post-op steroids), IOP spikes, Cataract.
 - Corneal burns, edema.
 - Retinal burns.
Argon Laser Trabeculoplasty.

Mechanism of action:
- Burns to the TM:
  - Increase outflow.
  - Stretch the juxtacanalicular meshwork or Schlemm's canal.
  - Change the biochemical behavior of the cells.
    - "Cleaning of the TM"
- Transient breakdown of the barrier.
- Inflow unchanged.
Argon Laser Trabeculoplasty.

Indications.

- POAG, not adequately controlled medically.
- Poor compliance with meds.
- Easier medical regimes.
- Cost.
- It may decrease IOP peaks, and lower mean IOP in supine position.\(^1\)

More than 180° open.

Limitation for Mixed and PCAG.

\(^1\) Ophthalmology, April 2007
ALT, Indications cont.

- Good temporary response in other non-inflamatory open angle glaucoma.
- PXS.
- Pigmentary glaucoma.
Indications of ALT cont.

- Mixed results.
- Post-filter.
- Pseudoaphakia.
- Aphakia.
- Residual open angle glaucoma.
- LTG.
- Subsequent 180°
Indications of ALT cont.

- Poor results in "secondary glaucoma"
- Congenital glaucoma.
- Juvenile glaucoma.
- Angle recession.
- Inflammatory glaucoma.
Contraindications of ALT.

- Corneal edema or scarring.
- Sealed TM
  - Avoid if less than half of the TM is free of PAS.
- Rubeosis, neovascular glaucoma.
- Inflammatory glaucoma.
- ICE syndrome.
Technique of ALT pre-op.

- Pre-op evaluation.
  - VA, slit lamp exam.
  - Gonioscopy.
  - IOP, pre-laser.
  - Optic nerve exam & fields.
  - Is ALT indicated?
  - Is its expected response adequate?
Technique of ALT pre-op.

- Written informed consent.  
  - take home the day the decision is made.
- Continue glaucoma therapy the day of the laser and post-laser.
- 0.5% iopidine pre & post laser.
  - decrease a possible 25% significant increase in IOP post-laser to less than 1%. 

Technique of ALT pre-op.

* Iopidine useless with:
  * Chronic use of Alphagan or Iopidine.
  * Try other medication.
    * Pilocarpine, Timolol.

* Use Pilocarpine pre-laser if not used chronically to avoid mydriasis.

* Attendant required.
Technique of ALT op.

- Topical anesthesia.
- Ritch lens.
  - Loupes magnify 1.4 x.
  - 59° inferior TM.
  - 64° superior TM.
- Aim at the center of the mirror and move the mirror clockwise.
Technique of ALT op.

- Initial inferior 180°.
- 45-50 burns to the anterior TM.
  - Junction of the pigmented with the non-pigmented TM.
- 0.10 sec/50µm/400-1200 mw (blue-green).
  - Blanch or small bubble.
Technique of ALT post-op.

- IOP monitoring.
  - 1-3 hrs post laser.
  - 24 hrs.
    - Iopidine will not prevent the rare 24 hr peak.
  - Aggressive use of CAI and/or osmotics if a rise greater than 5-7 mm Hg occurs in the presence of severe optic nerve damage.

- Reevaluation 4-6 wks.
Results of ALT.

- Drop in IOP proportional to pre-op level.
- Average 5-7 mm Hg drop in POAG, effect sustained for 2-3 years in 60-80%.
- May be effective in LTG.
- PXS may have greater effect.
- Less effective, <50 yrs.
GLT study (IOP success, 2 years) 
$180^\circ + 180^\circ$ treatment.

<table>
<thead>
<tr>
<th>Laser First.</th>
<th>%</th>
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<tbody>
<tr>
<td>ALT alone</td>
<td>44</td>
</tr>
<tr>
<td>ALT &amp; Timolol 0.5%</td>
<td>70</td>
</tr>
<tr>
<td>ALT and multiple meds.</td>
<td>89</td>
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<table>
<thead>
<tr>
<th>Medication First.</th>
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<tbody>
<tr>
<td>Timolol 0.5%</td>
</tr>
<tr>
<td>One Medication.</td>
</tr>
<tr>
<td>Multiple Medications.</td>
</tr>
</tbody>
</table>
Prognosis for ALT.

- Effect in 4-6 weeks.
  - Greater effect first year, then decline for the second and third year.
- Completion may provide some additional effect.
  - Lower than the initial treatment.
  - No effect on a third session.
- Danger of severe and sustained IOP elevation.
Complications of ALT.

- IOP spikes.
  - Protective effect of Iopidine.
  - Less frequent in 180° sessions and anterior burns.
  - Filtration shutdown by inflammatory debris.

- Iritis, 4-7 days self-limited.
  - Post-op topical steroids optional.
Complications of ALT.

- Small PAS frequent.
- Posterior burns.
- Narrow approach.
- Consider an iridoplasty or iridotomy first.
- Unknown significance.

- Endothelial & epithelial burns, self-limited.
Complications of ALT.

- Diffuse corneal edema
  - Chandler, Fuchs.
  - Time & topical steroids.
- Bleeding, rare.
  - Iris root or Schlemm’s canal.
  - 200-500 µm/ 0.5 sec/ 200-300 mw.
- Decrease success of future filtration surgery.
Complications of ALT.

- Pain.
  - Burns at ciliary body band.
- Progression of field defects.
  - Less than adequate response.
  - IOP spikes.
  - Sustained IOP elevation.
    - Avoid chronic angle closure glaucoma.
    - Third sessions.
Selective Laser Trabeculoplasty.
Background and Rationale.

- Limitations of argon laser trabeculoplasty (ALT)
  - Post-treatment increase in IOP; PAS
  - Limited efficacy of ALT re-treatment
  - Coagulative damage to the trabecular meshwork (TM)
- Selective laser trabeculoplasty (SLT) developed as an alternative to ALT
SLT: Mechanism of Action.

- Q-Switched frequency doubled (532 nm) Nd:YAG Laser.
- Selective targeting of pigmented trabecular meshwork (TM) cells without causing structural or coagulative damage to the TM.
SLT: Indications & Pre-op.

- Similar indications & results than ALT.
  - Plus treatment to fail post ALT.
  - Less potential damage to TM.
  - Early intervention?
  - Repeatable?
  - Less drop in IOP with each retreatment ¹.

- Needs an open angle.
  - More than 180° open.

- Pre-op, same as ALT.

SLT: Technique.

- 400 microns, 3 nsec.
- 40-60 spots, 180°.
  - 100, 360° more effective but greater risk of IOP spikes.
- 0.6-1.4 mJ.
  - Once you see bubbles, drop 0.1 mJ.
- Three mirror lens.
  - Do not use loupes of Ritch lens.
SLT, post-op.

- Similar to ALT.
- Potential for more than 2 sessions.
- Less inflammation.
- Less PAS.
- Watch IOP first day (1-2 hrs) and at 2 weeks.
Posterior Capsulotomy.

**Indications.**

- Opacified posterior capsule.
  - Impair VA & decrease quality of life.
  - Poor visualization of retina.
- Ciliary block glaucoma.
  - Document a patent PI first.
  - Medical Therapy fails.
  - Proceed with post. Capsulotomy.
  - If above fails, break Ant. Hyaloids with the YAG.
Posterior Capsulotomy.

Pre-op.
- VA, IOP, SLE exam.
- Informed consent.
  - Explain about incidence of RD (1/200).
  - Myopes retina consult?
- Dilate pupil, Iopidine.
- Abraham capsulotomy lens
  - (central 66 Δ)
- Topical anesthesia.
- Attendant required.
Posterior Capsulotomy.

 Technique.

- Try a posterior capsulorrhexis.
- 1-2 mJ.
- Use +1.5-2.5 Δ posterior de-focus.
- Shot calmly, avoid the IOL.
Posterior Capsulotomy.

- Post-op.
  - IOP plus 1-2 hrs.
  - Aggressive treatment of IOP spikes (>10 mmHg).
  - Continue medical therapy.
  - Topical steroids for a few days needed in some patients.
Posterior Capsulotomy.

**Complications.**
- IOP spikes.
- Glaucoma patients.
- Laborious capsulotomies.
- Iritis.
- Retinal detachment.
- First six months critical.
Laser suture lysis.

- **Indications.**
  - IOP not low enough.
  - Small failing belbs.
  - Always r/o a seidel first.
- Wait at least 2 weeks.
  - Few exceptions (in those burn one suture only).
- Attempt one suture at a time.
  - Massage.
  - IOP, check at the SLE.
Laser suture lysis.

- Technique.
  - Hoskins lens or edge of 4 mirror.
  - Topical anesthesia.
  - Argon, blue-green.
    - Lasers with red is easier.
  - 0.1 sec./50-100 microns/300-500 mW.
  - Shot calm and with confidence.
Laser suture lysis.

Complications.

- Failure.
  - Wait too long, in some cases 4 weeks is late.

- Hypotony.
  - Huge blebs.
    - Corneal changes.
    - Changes in vision.
    - Choroidal effusion/hemorrhage.

- Seidel.

- Conjunctival burns/holes.
  - Too much power, poor focus control.
Nd:YAG trabeculopuncture.

- Congenital & Juvenile Glaucoma.
  - limited effect “holes” close.
  - may further elevate IOP, bleeding.
  - 10 mJ single bursts pulses.

- Opening of failing sclerostomies.
  (Zeiss)
  - multiple 8-10 mJ bursts to sclerostomy site.

- Massage, IOP, SLE exam,
  - 20-30% effective.
Goniophotocoagulation, don’t do it!

- Rubeosis, pre sealing of TM.
  - limited use, disease origins should be treated.
  - 200 µm / 0.2-0.5 sec / 200-400 mw.

- Complications.
  - bleeding, inflammation.
  - may accelerate sealing of the angle.
Near future.

*Sapphire laser trabeculoplasty.*

*SOLX 790 OccuLogix.*

*790 nm, 180°, 50 spots, 30-80 mJ.*

*End-point, small vapor bubble.*

*25% IOP drop up to 12 months.*

*Less thermal damage than ALT, SLT.*

*Waiting FDA.*
SOLX 790 OccuLogix

<table>
<thead>
<tr>
<th>SOLX® 790 LASER</th>
<th>ALT</th>
<th>SLT</th>
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<tbody>
<tr>
<td>Laser Type</td>
<td>Argon</td>
<td>Frequency Doubled Q-Switched Nd:YAG</td>
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<tr>
<td>Wavelength</td>
<td>405 &amp; 514 nm (blue-green)</td>
<td>790 nm (Infrared)</td>
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<tr>
<td>Energy/Power per Pulse</td>
<td>0 to 1 Watt</td>
<td>30 to 80 millijoules</td>
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<tr>
<td>Pulse Duration</td>
<td>0.1 to 1 second</td>
<td>7 microseconds</td>
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<tr>
<td>Pulse Rate</td>
<td>Continuous Wave</td>
<td>Single Shot and Single Shot</td>
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<tr>
<td>Spot Size</td>
<td>50 to 500 micron</td>
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<tr>
<td>Peak Power (max)</td>
<td>2 W</td>
<td>11 kW</td>
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<tbody>
<tr>
<td>Absorption</td>
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<tr>
<td>Penetration</td>
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<tr>
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<td>Thermal Damage</td>
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<td>Low</td>
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<tr>
<td>Repeatable</td>
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<td>Yes</td>
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Argon 488-514 nm Blue-Green
SLT 532 nm Green
SOLX® 790 nm Near Infrared

Trabecular Meshwork
Schiemann's Canal
Conclusion.

- Success in anterior segment laser surgery depends on
  - To have the correct indications.
  - Adequate patient selection.
  - Careful attention to technique and follow up.
  - Keep up today.