

LASER TREATMENT

Laser treatment

- I. Why laser treatment?
- II. Laser trabeculoplasty
- III. Iridotomy
- IV. Iridoplasty
- V. Cyclophotocoagulation
- VI. Key points

Open-angle glaucoma

- Outflow enhancement
 - Laser trabeculoplasty
- Inflow reduction
 - Cyclophotocoagulation
(usually for end-stage disease)

Angle closure (\pm glaucoma)

- Relief of pupillary block
 - Laser iridotomy
- Modification of iris contour
 - Laser iridoplasty
- Inflow reduction
 - Cyclophotocoagulation
(usually for end-stage disease)

Post-operative treatment

- Laser suture lysis
 - Adjunct to trabeculectomy
- Laser sclerostomy
- Laser goniopuncture
 - Adjunct to non-penetrating surgery

Laser trabeculoplasty

| | |
|-------|--|
| Why? | <ul style="list-style-type: none">• Relatively effective• Relatively non-invasive |
| What? | <ul style="list-style-type: none">• Laser treatment to the trabecular meshwork to increase outflow |

Laser trabeculoplasty

When?

- Medical therapy failure or inappropriate
- Adjunct to medical therapy
- Primary treatment if appropriate

Laser trabeculoplasty: pre-laser management

- Pre-laser management
 - Explain the procedure and obtain informed consent
 - To reduce post-treatment IOP spike or inflammation, consider pre-treatment with:
 - 1% apraclonidine or 0.2% brimonidine, and/or
 - 2–4% pilocarpine and/or
 - β -blocker and/or
 - steroid drops
 - Topical anaesthesia

Laser trabeculoplasty: how?

- Laser management
 - Argon green or blue-green trabeculoplasty (ALT)
 - Diode
 - Selective laser trabeculoplasty (SLT) using a frequency-doubled Nd:YAG laser
- Lens
 - Without magnification
(e.g. Goldmann-style 3-mirror lens)
 - With magnification
(e.g. Ritch trabeculoplasty lens)

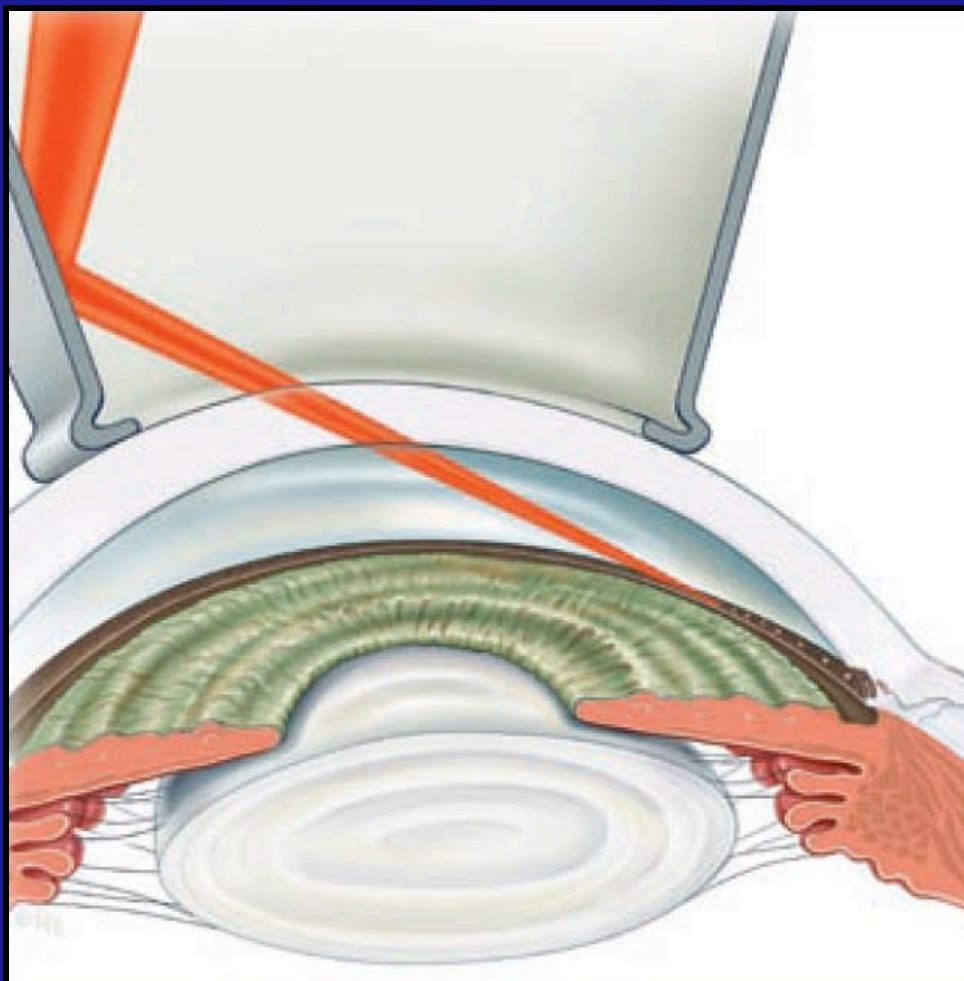
Nd:YAG, neodymium: yttrium-aluminium-garnet.

Laser trabeculoplasty: how?

- Placement of laser spots
 - Between pigmented and non-pigmented trabecular meshwork
- Laser parameters

| | |
|-----------------|--|
| Power | <ul style="list-style-type: none"> • 300–1200 mW, depending on the reaction |
| Spot size | <ul style="list-style-type: none"> • 50 μm (for ALT) • 75 μm (for diode) • 400 μm (for SLT) |
| Duration | <ul style="list-style-type: none"> • 0.1 sec (for ALT and diode) • 3 nsec (for SLT) |
| Number of burns | <ul style="list-style-type: none"> • 30–50 spots evenly spaced over 180° • Treat the remaining 180° sequentially or at the same time, as required |

Argon laser trabeculoplasty: how?



Argon laser trabeculoplasty

- Ideally, the spots should be applied over Schlemm's canal, avoiding the iris root: at the junction of the anterior 1/3 and posterior 2/3 of the meshwork
- The energy level should be set to induce a reaction from a slight transient blanching of the treated area to small bubble formation

Argon laser trabeculoplasty: complications

- Temporary blurring of vision
- IOP spike with possible visual field loss
- Transient iritis
- Peripheral anterior synechiae if placement of burns is too posterior or post-laser inflammation control is not effective
- Endothelial burns if treatment too anterior
- Chronic increase in IOP

Selective laser trabeculoplasty

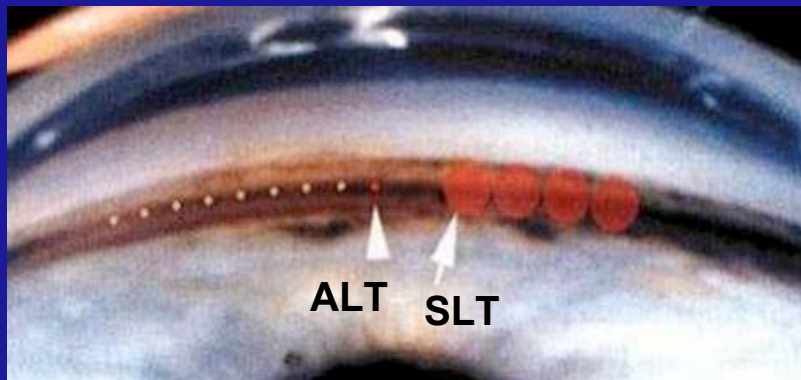
- SLT targets pigmented trabecular meshwork (TM) cells without causing thermal damage to non-pigmented cells or structures

Selective laser trabeculoplasty: how?

- Frequency-doubled, Q-switched Nd:YAG laser:
 - 532 nm
 - pulse duration 3 nsec
 - spot size 400 μm (large enough to cover the entire antero-posterior height of the TM)
- Nasal 180 degrees, 0.8 mJ
- End points – minimal bubble or no bubble

Comparison of selective and argon laser trabeculoplasty

SLT is not ALT...



Spot size comparison

ALT 50 μm

SLT 400 μm

| Parameter | ALT | SLT |
|----------------|---------------------------|------------------------|
| Spot size | 50 μm | 400 μm |
| Energy output | 500–1000 mW | 0.8–1.5 mJ |
| Pulse duration | 100 msec | 3 nsec |
| Fluence | 60,000 mJ/cm ² | 600 mJ/cm ² |

Laser trabeculoplasty: post-laser management

- Post-laser management
 - Continue current medical treatment
 - Re-check IOP at 1–6 hours after laser management, and again after 24–48 hours
 - Especially if IOP spike prevention treatment is not available
 - Topical steroid 4×/day for 4–14 days (consider omitting with SLT)

Laser trabeculoplasty: post-laser management

- Post-laser management (ALT)
 - Closer monitoring is suggested for:
 - advanced glaucoma patients with severe field loss
 - one-eyed patients
 - patients with high pre-laser IOP
 - patients who have undergone previous ALT

Laser trabeculoplasty: repeat treatment



- Repeat treatment
 - Laser trabeculoplasty can be repeated, especially in eyes that have shown a prolonged response to previous treatment

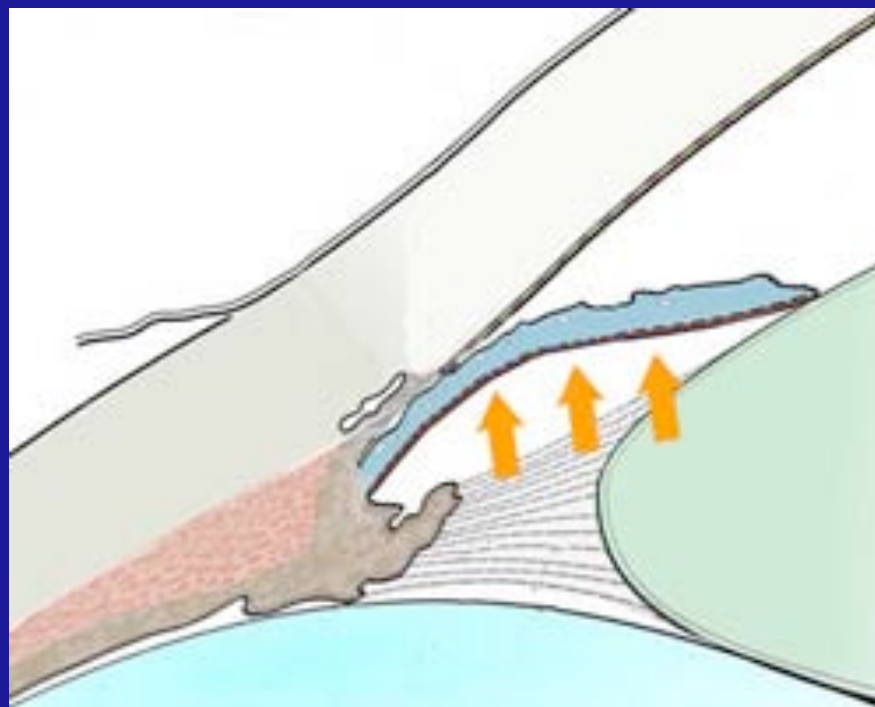
Iridotomy

| | |
|-------|---|
| Why? | <ul style="list-style-type: none">• Effective for pupillary block• Relatively non-invasive• Preferable to surgical iridectomy |
| What? | <ul style="list-style-type: none">• Laser treatment to connect the anterior and posterior chambers to relieve pupillary block |

Iridotomy: indications

- Absolute indications
 - Presence or likelihood of pupillary block
 - Angle closure
 - Angle-closure glaucoma
 - Occludable angle
 - Angle closure in fellow eye
 - Confirmed family history of angle-closure glaucoma
- Relative indications
 - Occludable angle
 - Need for repeated dilated examinations
 - Poor access to regular ophthalmic care

Relative pupillary block



Picture courtesy of Murali Ariga

Iridotomy: how?

- Pre-laser management
 - Explain the procedure and obtain informed consent
 - Instill 2% or 4% pilocarpine (aim for miosis)
 - To reduce post-treatment IOP spike or inflammation, consider pre-treatment with:
 - 1% apraclonidine or 0.2% brimonidine and/or
 - β -blocker and/or
 - oral carbonic anhydrase inhibitor and/or
 - steroid drops
 - Topical anaesthesia

Iridotomy: how?

- Laser management
 - Nd:YAG alone
 - Argon, krypton or diode may be used alone or in combination with Nd:YAG
 - Use of Nd:YAG – alone or in combination with argon, krypton or diode – is preferred
- Choice depends on the nature of the iris and other factors

Iridotomy: how?

- Argon laser pre-treatment can facilitate penetration of a uniformly thick iris by:
 - coagulating the target area
 - stretching the target area
 - thinning the target area
- Argon pre-treatment is followed by Nd:YAG laser

Iridotomy in Asian eyes

- Asian patients have thick and heavily pigmented irides
- Some surgeons may prefer using the Nd:YAG laser alone or argon laser pre-treatment followed by Nd:YAG laser

Iridotomy: where?

- Parameters for Nd:YAG laser
 - Superior 1/3 of iris (beneath upper lids) desirable
 - Choose an iris crypt or an area of thin iris
 - Focus the beam within the iris stroma rather than on the surface of the iris

Iridotomy: how?

- Parameters for Nd:YAG laser
 - Energy: 2–5 mJ, 1–3 pulses per burst
 - Use minimum energy
 - Lens damage is possible above 2 mJ per pulse
 - Nd:YAG laser, alone or in combination with argon laser, is the preferred approach

Iridotomy: how?

- Parameters for argon laser

| Parameter | Preparatory stretch burns | Penetration laser burns |
|----------------------|---------------------------|-------------------------|
| Power | • 200–600 mW | • 800–1000 mW |
| Spot size / diameter | • 200–500 μm | • 50 μm |
| Exposure time | • 0.2–0.5 sec | • 0.02 sec |

- Choose and modify parameters based on individual response

Patent iridotomy

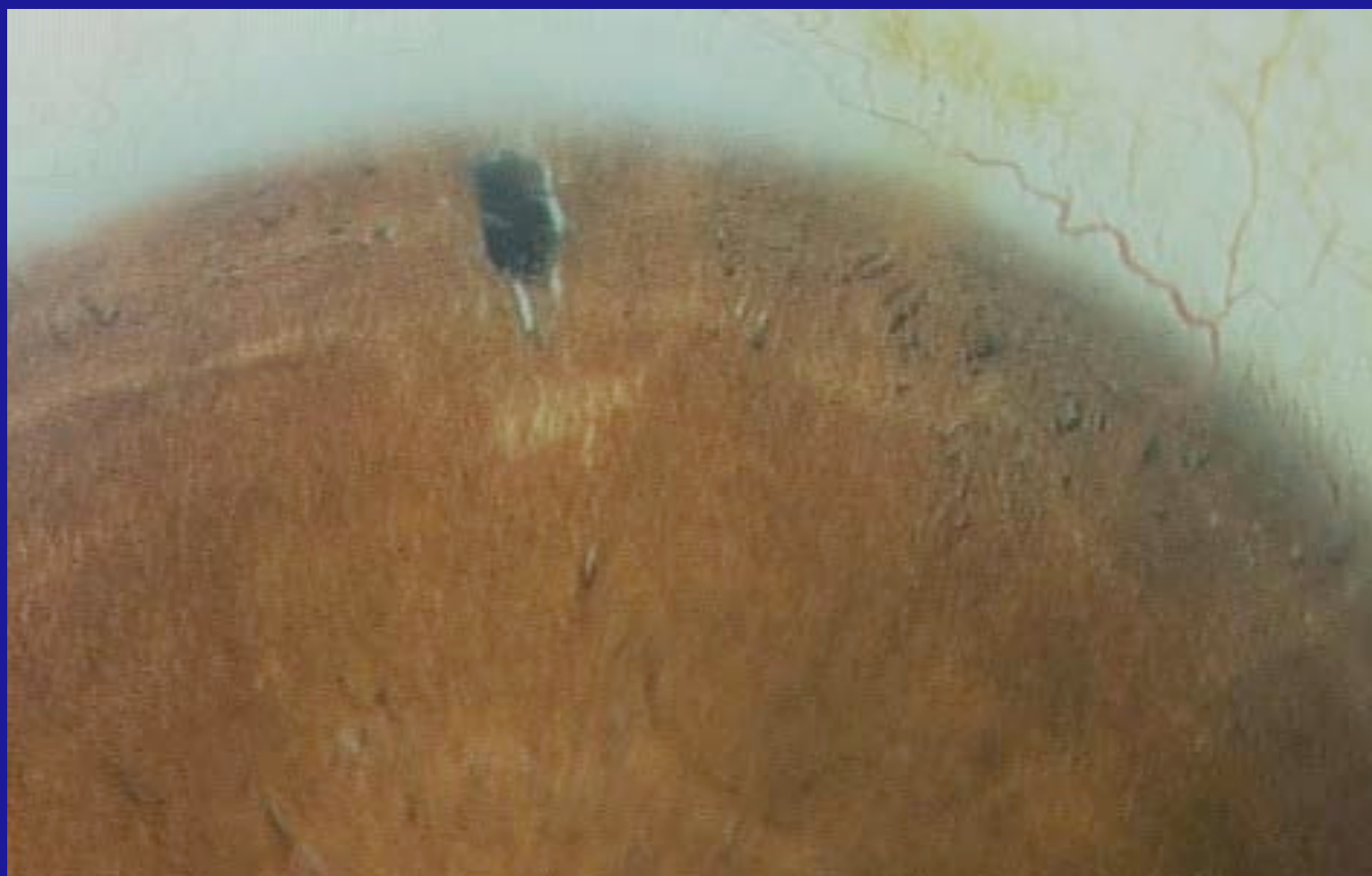
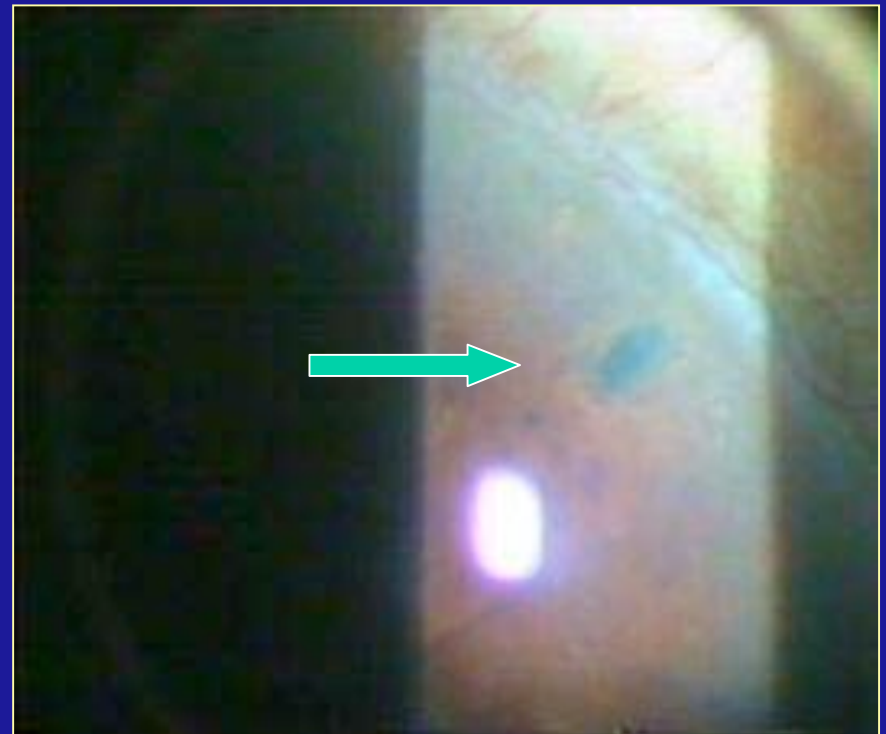
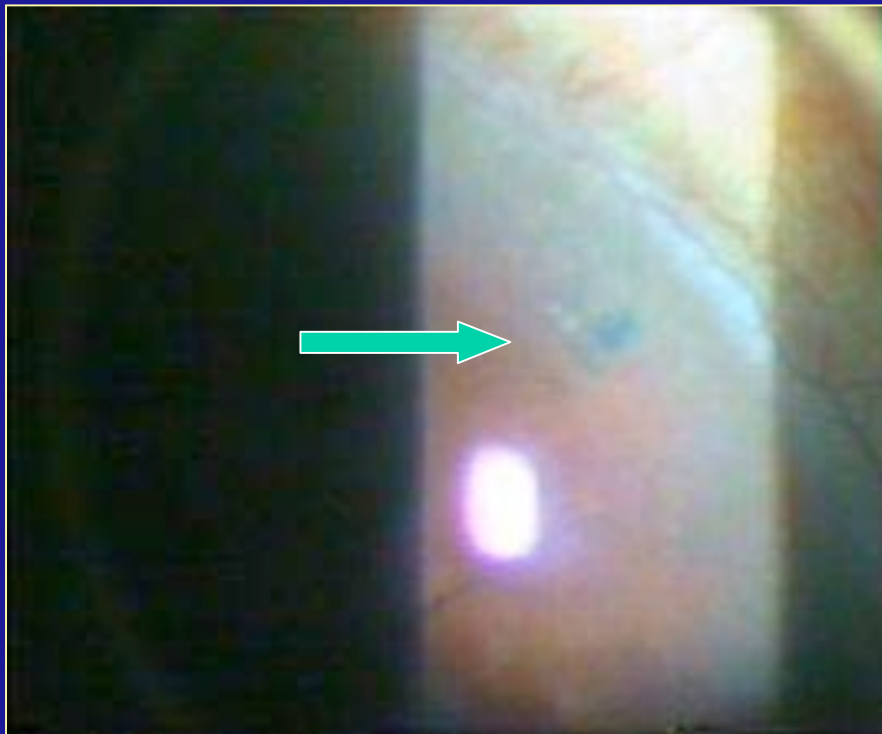


Photo courtesy of Sunil Jain

Nd:YAG iridotomy



Photos courtesy of Murali Ariga

Nd:YAG iridotomy: demonstration



Video courtesy of Ravi Thomas

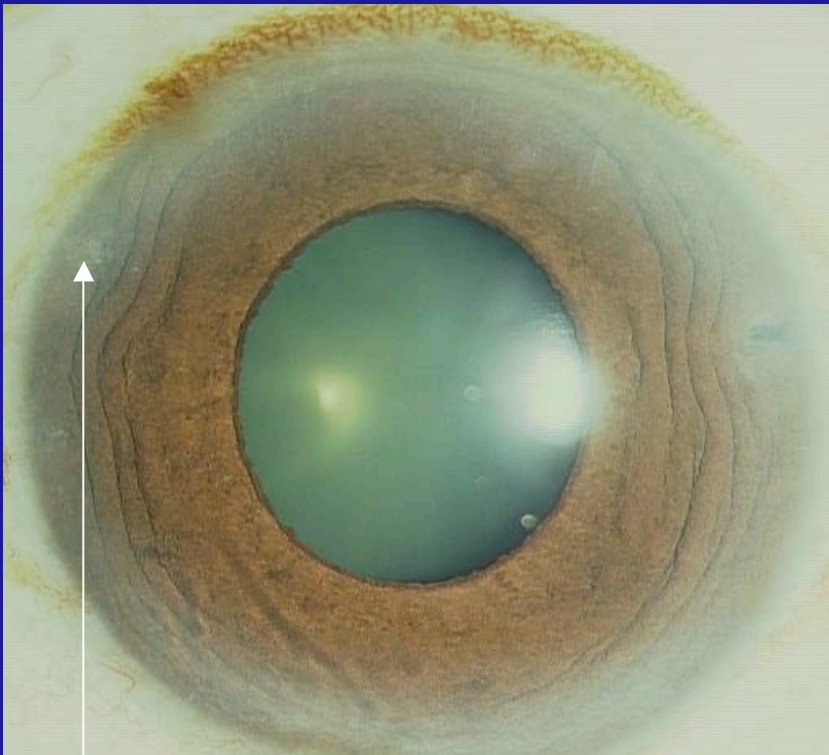
Iridotomy: endpoint?

- Fluid/pigment puff
- Verify the patency of the peripheral iridotomy
 - Use direct visualisation, not retro-illumination alone
- Ensure the size of the peripheral iridotomy is adequate ($\geq 150 \mu\text{m}$)

Iridotomy in pupillary block

- More than one iridotomy may be preferable in pupillary block due to uveitis
- A larger iridotomy (400 μm) is required in cases of uveitis

Iridotomy patency: transillumination test



Attempted iridotomy with
failure to penetrate

Patent iridotomy in the
same eye



Iridotomy: complications

- Temporary blurring of vision
- Corneal epithelial and/or endothelial burns with argon
- Intra-operative bleeding with Nd:YAG
- IOP spikes
- Post-operative inflammation
- Posterior synechiae
- Closure of iridotomy
- Failure to penetrate
- Localised lens opacities
- Rarely: retinal damage, cystoid macular oedema, malignant glaucoma, endothelial decompensation

Iridotomy: how?

- Post-laser management
 - Re-check IOP at 1–6 hours after laser management and again after 24–48 hours
 - Especially if IOP spike prevention treatment is not available
 - Topical steroid at least 4–6×/day for 4–14 days depending on inflammation
 - Verify the patency of the peripheral iridotomy
 - Repeat gonioscopy after withdrawal of pilocarpine
 - Pupillary dilatation to break posterior synechiae when suspected

Iridoplasty

| | |
|-------|---|
| Why? | <ul style="list-style-type: none">• Reasonably effective• Relatively non-invasive• Adjunct to peripheral iridotomy |
| What? | <ul style="list-style-type: none">• Laser treatment to contract the peripheral iris<ul style="list-style-type: none">– Flatten the peripheral iris– Widen the anterior chamber angle inlet |

Iridoplasty

When?

- Angle remains occludable following peripheral iridotomy (e.g. plateau iris)
- Help break an attack of acute angle closure
- Facilitate access to the trabecular meshwork for laser trabeculoplasty
- Minimise the risk of corneal endothelial damage during iridotomy

Iridoplasty: how?

- Pre-laser management
 - Explain the procedure and obtain informed consent
 - Instill 2% or 4% pilocarpine (aim for miosis)
 - To reduce post-treatment IOP spike or inflammation, consider pre-treatment with:
 - 1% apraclonidine or 0.2% brimonidine and/or
 - β -blocker and/or
 - oral carbonic anhydrase inhibitor and/or
 - steroid drops
 - Topical anaesthesia
 - Topical glycerine, if the cornea is oedematous

Iridoplasty: how?

- Laser management
 - Argon green or blue-green
 - Diode laser
 - Burns should be as peripheral as possible
- Lens
 - Abraham lens or the Goldmann three-mirror lens
 - Alternative lens
- Endpoint
 - Iris contraction with peripheral anterior chamber deepening and more visible angle in line with the laser applications

Iridoplasty: how?

- Placement of laser spots
 - Aim at the most peripheral location
 - Avoid corneal arcus
- Laser parameters

| | |
|-----------------|---|
| Power | <ul style="list-style-type: none"> • 200–400 mW, depending on the reaction (i.e. iris contraction) |
| Spot size | <ul style="list-style-type: none"> • 200–500 μm (or a smaller spot size) |
| Duration | <ul style="list-style-type: none"> • 0.2–0.5 sec |
| Number of burns | <ul style="list-style-type: none"> • 30–50 applications over 360° • Leave at least 1–2 spot diameters between spots |

Iridoplasty: complications

- Mild iritis
- Corneal endothelial burns
- IOP spikes
- Peripheral anterior and/or posterior synechiae

Iridoplasty: post-laser management

- Re-check IOP at 1–6 hours after laser management and again after 24–48 hours
 - Especially if IOP spike prevention treatment is not available
- Topical steroid 4–6×/day for 7 days or more depending on inflammation
- Repeat gonioscopy after withdrawal of pilocarpine to:
 - evaluate the anterior chamber angle
 - identify any other mechanism(s) of angle closure that might necessitate further intervention

Cyclophotocoagulation

| | |
|-------|---|
| Why? | <ul style="list-style-type: none"> • Preferable to cyclocryoablation or cyclodiathermy |
| What? | <ul style="list-style-type: none"> • Reduces aqueous production by destruction of ciliary epithelium |
| When? | <ul style="list-style-type: none"> • Failure of multiple filtering surgeries • Primary procedure to alleviate pain in neovascular glaucoma with poor visual potential • Painful blind eye • Surgery not appropriate |

Cyclophotocoagulation: how?

- Pre-laser management
 - Explain the procedure and obtain informed consent
 - Topical and sub-Tenon's or retro/peribulbar anaesthesia
 - General anaesthesia when indicated

Cyclophotocoagulation: how?

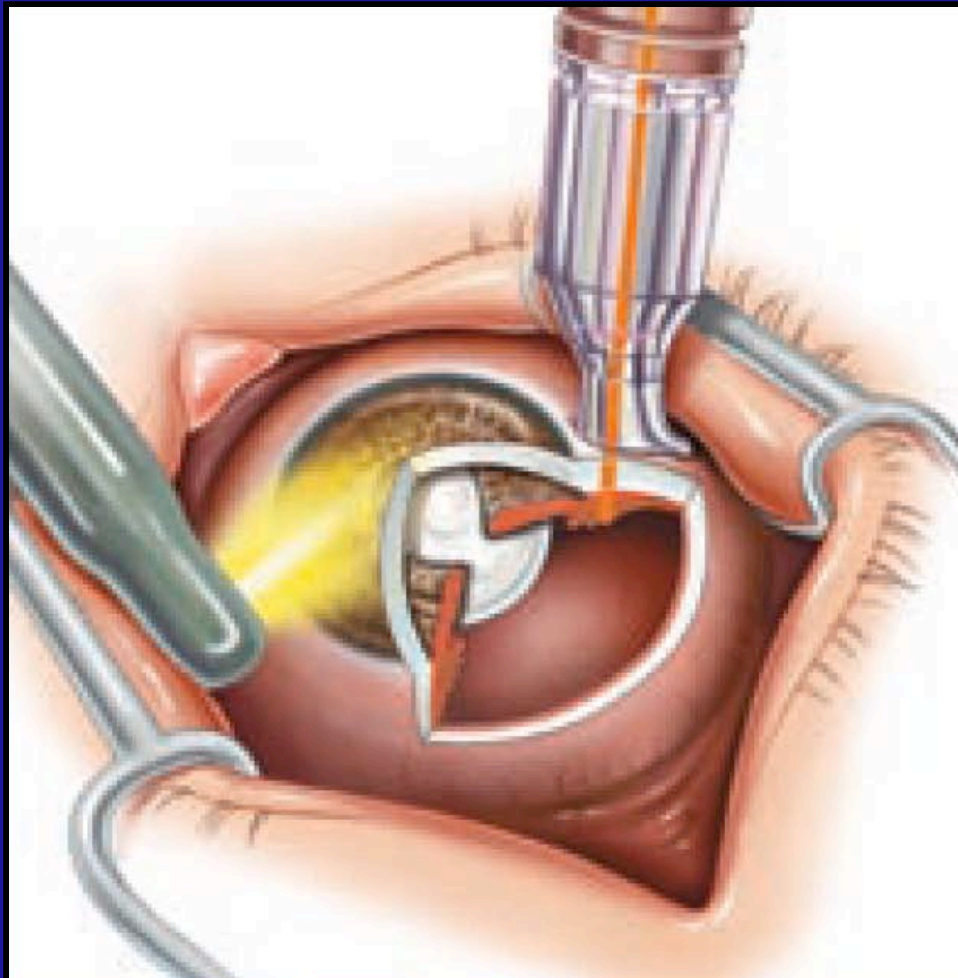
- Techniques
 - Transscleral
 - Transpupillary
 - Endolaser
- Conservative, incremental applications avoiding 3 and 9 o'clock positions

Cyclophotocoagulation: how?

- Contact diode laser
 - Diode laser with transscleral contact probe
 - Laser parameters

| | |
|-----------------|-------------------------------------|
| Power | • 1.0–2.5 W |
| Duration | • 0.5–2.0 sec |
| Number of burns | • 20–40 applications over 180°–360° |
| Location | • 1–2 mm from limbus |

Cyclophotocoagulation: how?



Contact transscleral diode laser

- Check and clean the probe before each use
- The fibre-optic laser tip of the probe is 1.5 mm behind the anterior edge of the footplate and protrudes 0.7 mm
- The laser tip should be placed over the ciliary body. Indentation improves energy delivery and blanches conjunctival blood vessels.
- The figure shows a relatively posterior ciliary body treatment, which may improve pressure reduction

Cyclophotocoagulation: how?

- Endolaser
 - Diode endoscopic laser
 - Argon or krypton laser
 - Laser parameters
 - Depends on laser system used
 - Consult instruction manual and clinical updates

Cyclophotocoagulation: complications

- Pain
- Persistent inflammation
- Loss of visual acuity
- Hypotony
- Scleral thinning
- Macular oedema
- Retinal detachment
- Aqueous misdirection syndrome
- Phthisis
- Sympathetic ophthalmia
- Failure to control IOP – multiple procedures may be needed

Cyclophotocoagulation: how?

- Post-laser management
 - Analgesia
 - Continue current treatment
 - Check IOP after 24–48 hours
 - Topical steroid 4–6×/day for 14 days or more depending on inflammation
 - Cycloplegia 2–4×/day for 7–14 days

Key points

- Consider pre-treatment with drops to reduce post-treatment IOP spikes
- Choose and modify laser parameters depending on the individual
- Be aware of complications
- Post-laser management according to guidelines