

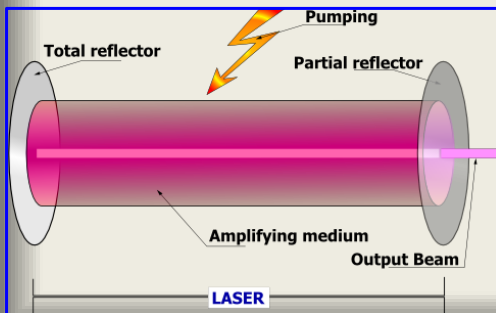
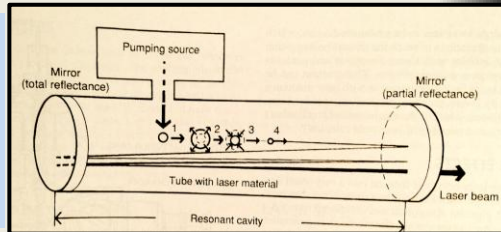
LASERS IN GLAUCOMA MANAGEMENT

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MAGRABI HOSPITALS & CENTERS

Basic Principles of LASERS

- Light amplification by stimulated emission of radiation



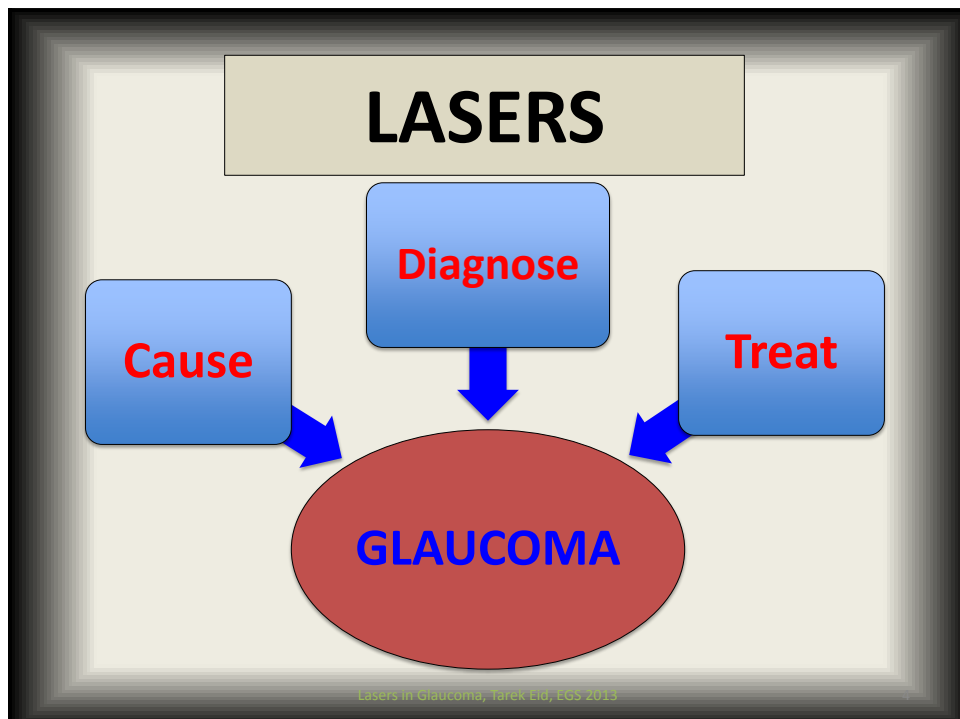
- The emitted light is
 1. Coherent (in phase),
 2. Collimated (rays in same direction),
 3. Monochromatic (one wave length)
 4. High intensity (amplified)

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Specific LASERS & Tissue Interactions

Type of Laser	Wavelength	Effect on tissue
Argon laser	514-488 (blue & green light)	Photocoagulation
Nd:YAG laser (pulsed)	1064 (near infrared)	Photodisruption
Nd:YAG, freq. doubled	532-nm	Photocoagulation
Diode laser	800-820-nm (infrared)	Photocoagulation
Carbon Dioxide	10600 (far infrared)	Photovaporization
Femto second laser	1053 (near infrared)	Photodisruption
Krypton laser	670-531 (visible light)	Photocoagulation
Excimer laser	193 (far ultraviolet)	Phototablation
Ruby laser	694-nm (visible spectrum)	Phototablation
Helium-neon laser	(the red wave length)	An aiming beam

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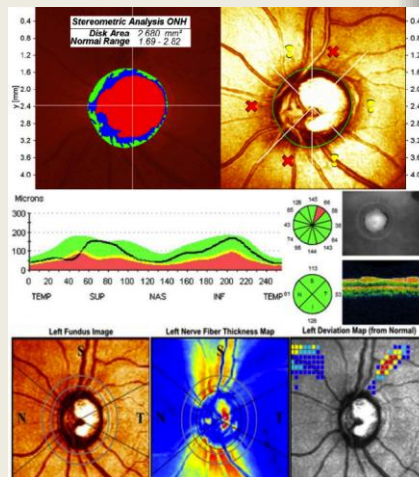
LASER-INDUCED GLAUCOMA

- Post laser pressure spikes & persistent IOP elevation after ant segment laser Sx: YAG cap, PI, LPI, ALT, pupilloplasty,...
- Experimental open-angle glaucoma (photocoagulation of TM): acute & chronic
 - Gaasterland D, Kupfer C. Experimental glaucoma in Rhesus monkeys. Invest Ophthalmol 1974;13:455
- YAG capsulotomy provoking rubeosis irides and neovascular glaucoma in diabetic eyes
- Malignant glaucoma post CPC
 - Hardten DR, Brown JD. Malignant glaucoma after Nd:YAG cyclophotocoagulation. Am J Ophthalmol 1991;111:245

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LASER APPLICATION FOR GLAUCOMA DIAGNOSIS

- Confocal laser scanning ophthalmoscopy (**HRT**, **TopSS**)
- Optical coherence tomography (**OCT**):
 - Post segment OCT
 - Ant segment OCT
- Laser scanning polarimetry (**GDX**)
- Retinal ganglion cell imaging

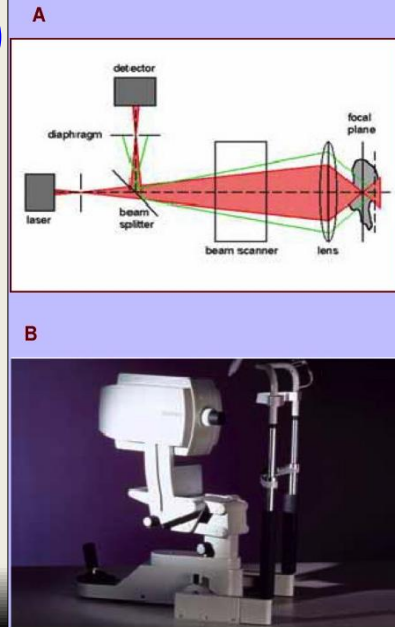


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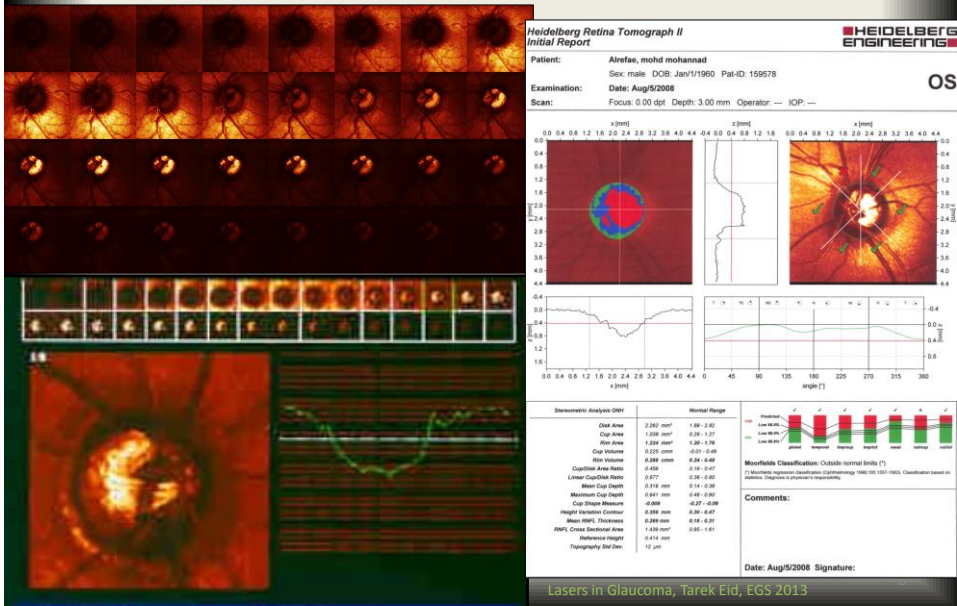
The Confocal Laser Scanning Ophthalmoscope (HRT)

- Uses laser beam to scan the target tissue one point at a time
- **A confocal optical system is utilized**
- The laser beam scans the ONH horizontally across a given plane then moves down to scan sequential planes

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Topography Image & Data Analysis

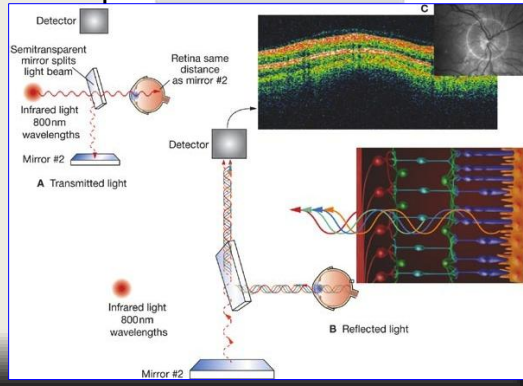
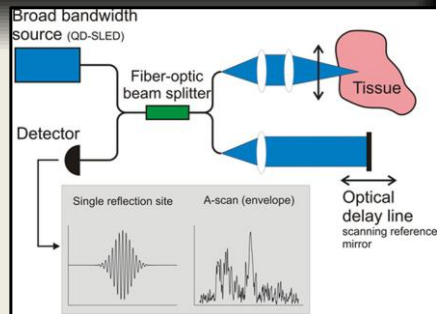


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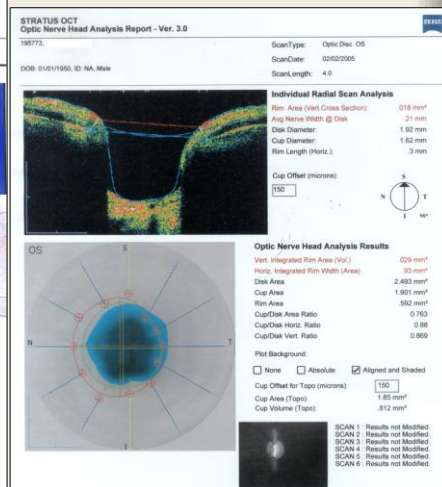
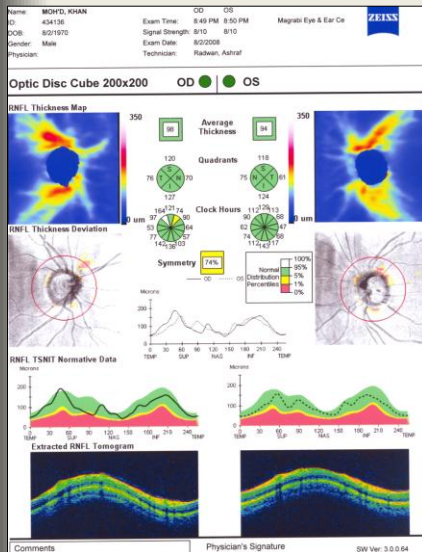
OPTICAL COHERENCE TOMOGRAPHY (OCT)

- **Optical Principles:** low coherence interferometry
- **Light source:** a broadband superluminescent light emitting diode
- The interferometer measures the **echo delay time** of the sample beam reflected from different microstructures in the retina & combines it with the reflected reference beam producing the phenomenon of interference
- A photodetector detects and measures interference (the echo delay patterns)

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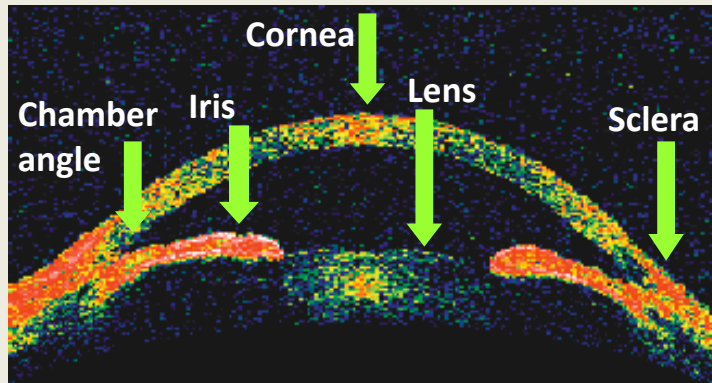
OCT Analysis of Optic Disc & RNFL



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What We see with Anterior Segment OCT:

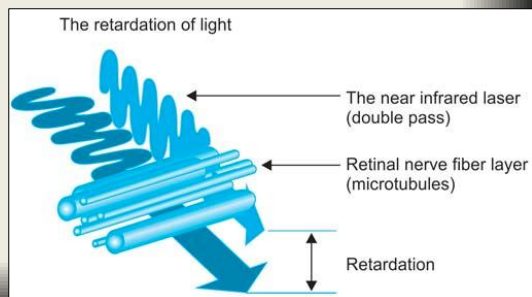
AC 15 mm scan



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Scanning Laser Polarimetry

- **Birefringence:** A property of a tissue or a material that arises when the tissue is composed of parallel structures, each of which is of smaller diameter than the wavelength of the incident light used to image it



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Nerve Fiber Analysis
With Variable Corneal Compensation

Normal Sample ID: 3128

DOB: Monday, April 17, 1950, Gender: Male, Ancestry: Black

Parameters	Actual Vol.	OS
TSNIT Average	53.08	61.32
Superior Average	57.94	79.03
Inferior Average	74.97	72.81
TSNIT Std. Dev.	27.14	30.01
Inter-Eye Symmetry	0.89	
NFI	27	3

TSNIT Graph: Shows TSNIT values for Superior, Inferior, and Nasal sectors for both eyes.

Thickness Map: Color-coded map of retinal nerve fiber thickness.

Deviation Map: Shows deviation from normal values.

TSNIT Graph: Line graph showing TSNIT values across sectors.

Normal NFL

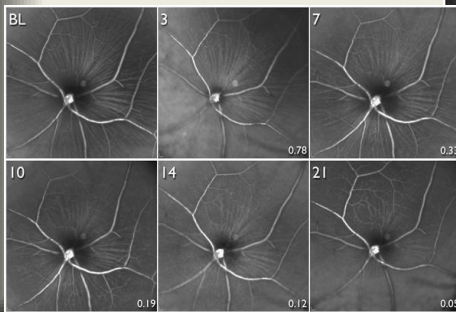
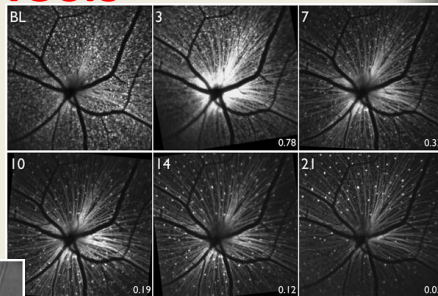
The GDX VCC Printout

- Disc photos
- TSNIT Parameters
- Thickness map
- Deviation map
- TSNIT Graph

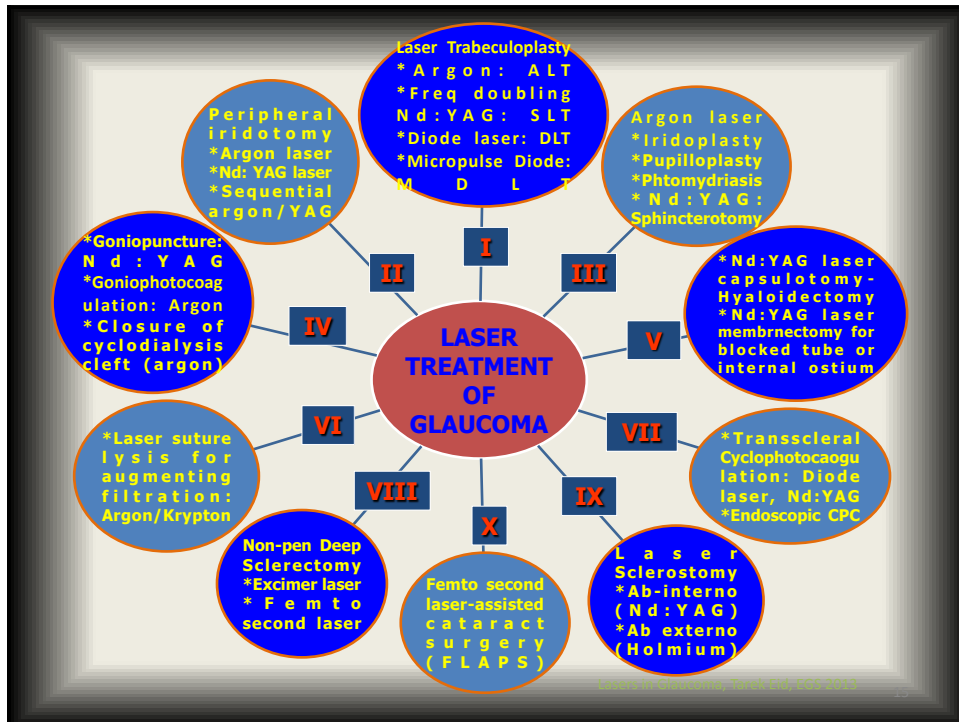
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LASER APPLICATION FOR GLAUCOMA DIAGNOSIS

- Investigational tools under study:
 - Longitudinal scanning laser ophthalmoscopy for Retinal ganglion cell imaging



Chauhan BC, Stevens KT, Levesque JM, Nuschke AC, et al. (2012) Longitudinal In Vivo Imaging of Retinal Ganglion Cells and Retinal Thickness Changes Following Optic Nerve Injury in Mice. PLoS ONE 7(6):



LASERS: THE SOFT POWER IN GLAUCOMA TREATMENT

- Except for ALT & SLT, all other lasers are substitutes for surgical intervention
- Being
 - Noninvasive,
 - Office procedures
 - Maximally tolerated
 - Least adverse effects
 - Targeting tissue of the main pathology
 - Average success rate
 - Average cost compared to drops or surgery
- make them preferred to surgery with regard to safety, efficacy, cost, and patient's acceptance
- SLT/ALT overcomes many of the adverse effects of medicinal therapy
 - Compliance to meds
 - Side effects of drug & preservative
 - Declining Persistence & tolerability to drops
 - Cost
 - Poor access to or non availability of drugs
 - Effect on future Sx
 - Quality of life & psychological stress



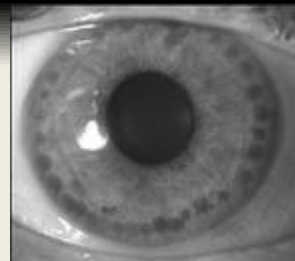
Indications for Laser Treatment for different types of glaucoma

Type of Glaucoma	Laser Procedure
• POAG, OH, PIGG, XFG	• ALT, SLT, DLT, MDLT
• PACG, PACS, Acute PACG, Plateau iris	• PI, Laser iridoplasty, femto laser cat sx
• 2ry pupillary block glaucoma: NVG, Uveitic, ...	• Multiple laser iridotomies
• Refractory glaucomas	• Trans-scleral CPC, Endoscopic CPC
• Malignant glaucoma	• YAG capsulotomy-hyaloidotomy
• Postoperative pressure spikes	• Laser suture lysis, Goniopuncture
• Neovascular glaucoma	• Goniophotocoagulation, Pan retinal photocoagulation
• Cyclodialysis cleft	• Argon laser treatment for closure of cleft
• Blocked tube or sclerostomy	• YAG laser membranectomy
• Surgical Rx of OAG	• Laser sclerostomy, Excimer laser Deep Sclerectomy

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ARGON LASER PERIPHERAL IRIDOPLASTY

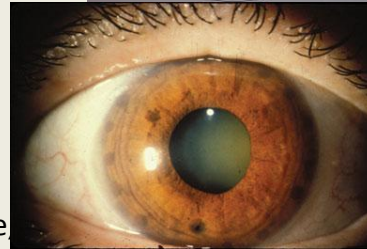
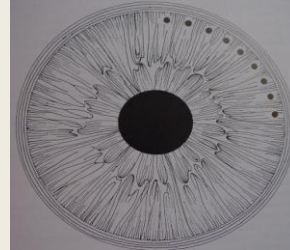
- Principle of treatment
- Indications
 - Plateau iris syndrome
 - Pupillary block with appositional angle closure when laser PI cannot be done or failed to open the angle
 - In nanophthalmos to relieve angle crowding
 - To open the angle before trabeculoplasty
- Contraindications:
 - Corneal edema, very shallow AC
 - Synechial angle closure



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ARGON LASER IRIDOPLASTY

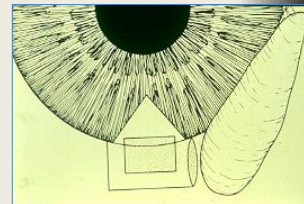
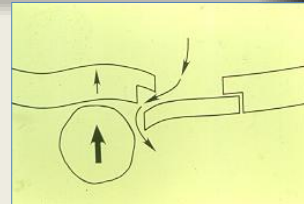
- **Technique:**
 - **Laser setting:** 300-500 μm spot size, 0.5 sec, 200-400 mW power
 - **Site of treatment:** extreme iris periphery
 - **Number of burns:** 20-40 over 360 degrees
 - Treatment of 180 degrees may be advisable
 - **End point:** visible brisk contraction of iris, no bubble or pigment release
 - The flat surface of a contact lens is preferred to goniolens
- **Complications:**
 - Iritis, endothelial edema, IOP rise, retinal burn, pupil changes



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LASER SUTURE LYSIS

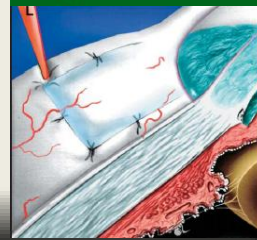
- Postop pressure rise due to tight scleral flap
- Sutures are Nylon or Prolene
- Exclude other causes of high IOP
- Used for titration of filtration postoperatively
- **Timing of LSL is very critical:**
 - Not before one week & may extend for 1 months with antimetabolites
 - CTM is done to test flap dislodgement and amount of flow
 - The postop target pressure
 - Intensity of the healing/scarring process



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LASER SUTURE LYSIS

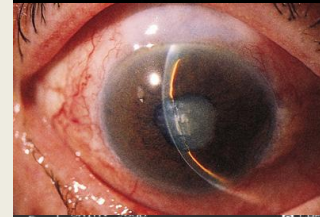
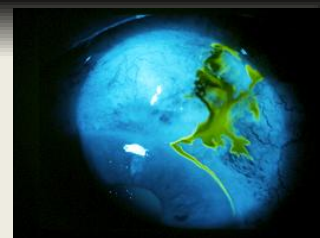
- **Technique**
 - Argon, Diode, or Krypton laser (if subconj. hemorrhage):
 - 500 mW, 100 microns spot size, 0.1 sec
 - Hoskins or Ritch lens
 - Local anesthesia
 - Suture compression by the lens with laser cutting under direct visualization
 - Light pressure with lens may help to dislodge tight flap & increase flow
 - Tarek Eid. Laser suture lysis after guarded filtering surgery: safety and effectiveness. Delta Ophthalmological Society Journal, April 2003



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LASER SUTURE LYSIS

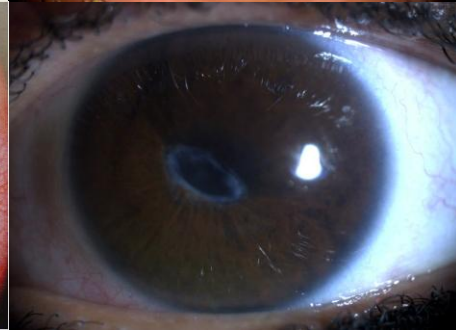
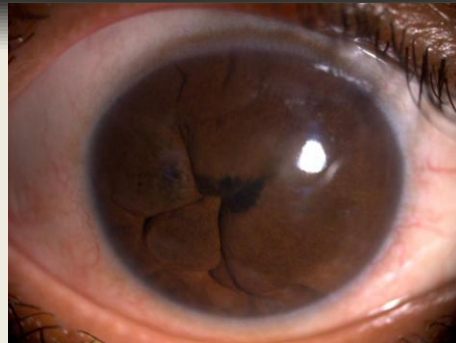
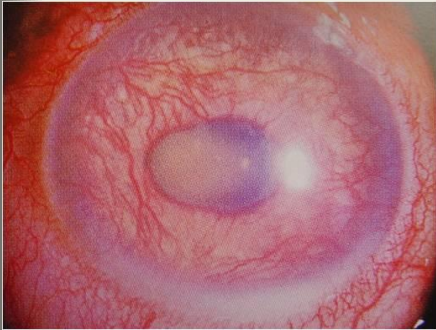
- **Precautions:**
 - Only one suture cut at a time
 - IOP must be checked after suture cutting
 - Slitlamp ex for AC, & Seidel test for leak
- **Complications**
 - Failure to locate or cut the suture
 - Failure to increase flow after suture cutting
 - Conjunctival buttonholes
 - Excessive flow & hypotony-related complications: lost AC, choroidal effusion
 - Malignant glaucoma



40mm FREEZE
Log
50dB
ip
TGC: -4.0/cm
3
10 110 120 130 140 150 160 170 180
HMED A. ALDAGREER 2 OD Oct 10 04 10:03

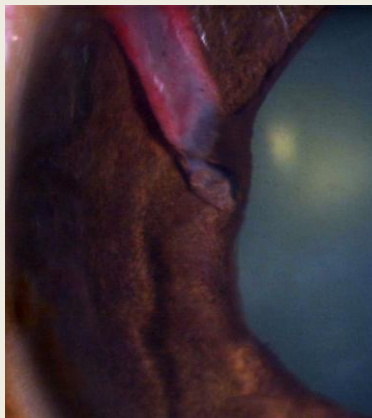
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**Multiple laser
iridotomies:**
Nd:YAG or
Sequential Argon &
YAG laser



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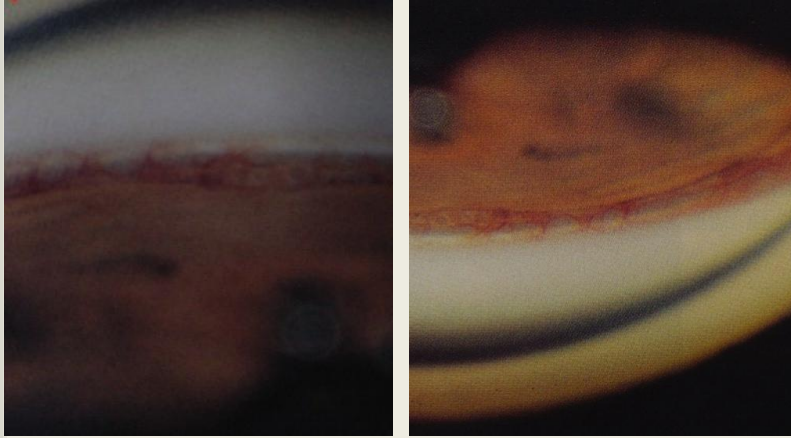
LASER MEMBRANECTOMY
For blocked tube or internal ostium



- Kirti Singh, **Tarek Eid**, et al. Evaluation of Nd: YAG laser membranectomy in blocked tubes after glaucoma tube-shunt surgery. *American Journal of Ophthalmology*, 1997;124.

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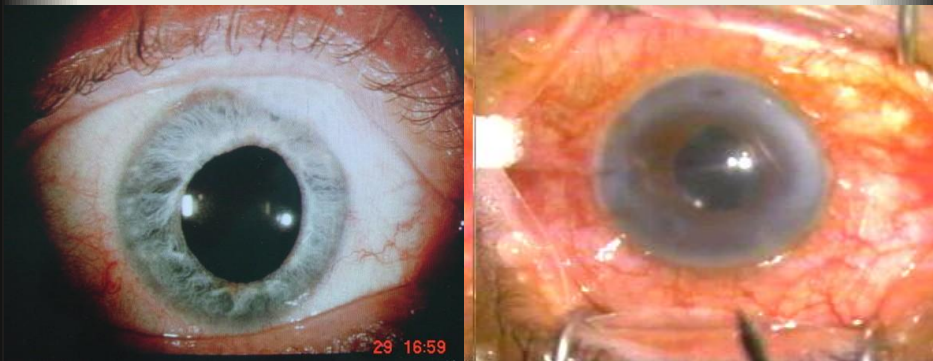
Argon laser Goniophotocoagulation for Open-angle Neovascular Glaucoma



Settings: 200 mW, 100-200 microns spot size, 0.2 sec

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YAG laser Capsulotomy/Hyaloidotomy for disruption of anterior vitreous face in **Malignant Glaucoma** in aphakic or pseudophakic eyes



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“Health Literacy” & Laser Glaucoma Treatment

- Poor health literacy is associated with lower compliance, poor glaucoma understanding, and more missed appointments, with subsequent more visual field loss

– Juzych MS, et. Functional health literacy in patients with glaucoma in urban settings. Arch Ophthalmol 2008;126:718-724

- **ABUSE** of the word **LASER** by the physician & the patient
- The **Underestimate & Overestimate** impression
- The **confusion** with other laser applications in the eye (laser in retina, refractive sx, cat sx, plastic sx...etc)

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GIVE YOUR PATIENT HOPE, NOT FEAR

- **Glaucoma for most patients is**
 - Bad disease
 - Incurable
 - Blinding
- **And for most eye care providers is**
 - Frustrating
 - No cure whatever you do
 - No appreciation whatever you do



- **FEAR is key to doctor visit**
- **Antidote to fear is HOPE**
- **There is no better feeling than walking out of the doctor's office with a good report**

– Brown RH. Hope, Not Fear: Talking to the glaucoma patients. Glaucoma Subspecialty Day, American Academy of Ophthalmology Meeting, Orlando 2011,

- **No patient should ever leave a visit with a physician without a sense of HOPE**

– Harris JC, DeAngelis CD. The power of hope. JAMA 2008;300(24):2919

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8

Thank U for the kind attention



Tarek Eid, MD