

الكلية التقنية الطبية
جامعة ساوه الأهلية

types of laser
third lecture
third class

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Laser

Introduction to Laser Principles and
Applications in Ophthalmology



Introduction to Lasers

- LASER = Light Amplification by Stimulated Emission of Radiation.
- Properties:
 - - Monochromatic: single wavelength
 - - Coherent: waves in phase
 - - Collimated: parallel beams
 - - High intensity: concentrated energy
- These unique features allow safe, precise treatment of delicate ocular tissues.

Types of Ophthalmic Lasers

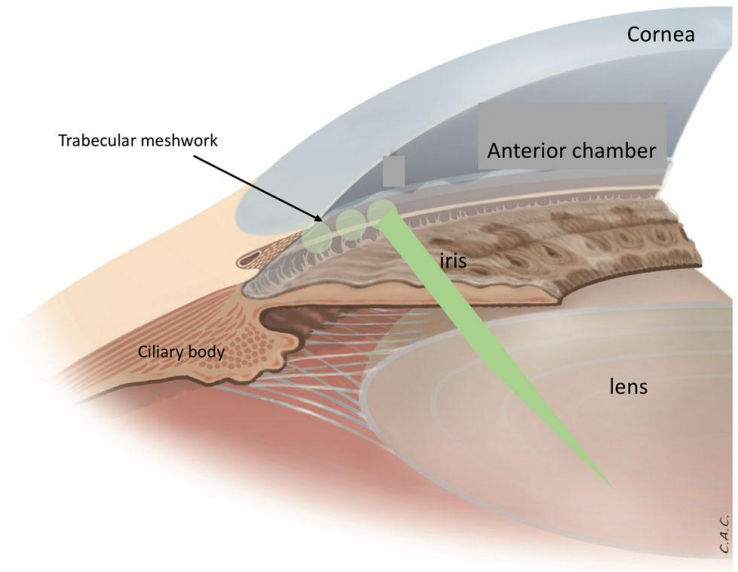
- • Argon Laser (488–514 nm): retinal photocoagulation, trabeculoplasty
- • Nd:YAG Laser (1064 nm): capsulotomy, iridotomy
- • Excimer Laser (193 nm): corneal reshaping in PRK, LASIK
- • Diode Laser (810 nm): PRP, cyclophotocoagulation
- • Femtosecond Laser: LASIK flap creation, cataract surgery incisions

Mechanisms of Action

- • Photocoagulation: burns coagulate proteins (retina, glaucoma)
- • Photodisruption: shock waves break tissue (Nd:YAG capsulotomy)
- • Photoablation: excimer laser removes tissue at molecular level (PRK, LASIK)
- • Photothermal: controlled heating (glaucoma treatment)
- • Photodynamic Therapy (PDT): verteporfin + diode laser for AMD

Glaucoma – Laser Trabeculoplasty

- ALT (Argon Laser Trabeculoplasty): Argon laser creates thermal burns that stretch trabecular meshwork.
- SLT (Selective Laser Trabeculoplasty): Nd:YAG (532 nm) selectively targets pigmented trabecular cells.
- Indications:
 - - Open-angle glaucoma uncontrolled by medications
 - - Patients intolerant to drops
- Safer repeatability with SLT.



Glaucoma – LPI and CPC

- LPI (Laser Peripheral Iridotomy):
Nd:YAG/Argon creates a small hole in peripheral iris.
- - Relieves pupillary block in angle-closure glaucoma.
- CPC (Cyclophotocoagulation):
Diode laser ablates ciliary body.
- - Reduces aqueous humor production.
- - Used in refractory/advanced glaucoma with poor prognosis.

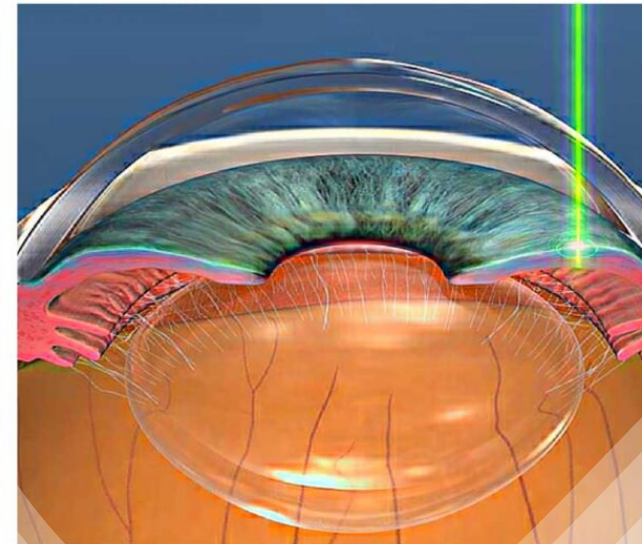
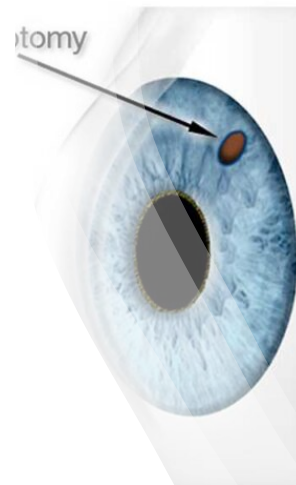
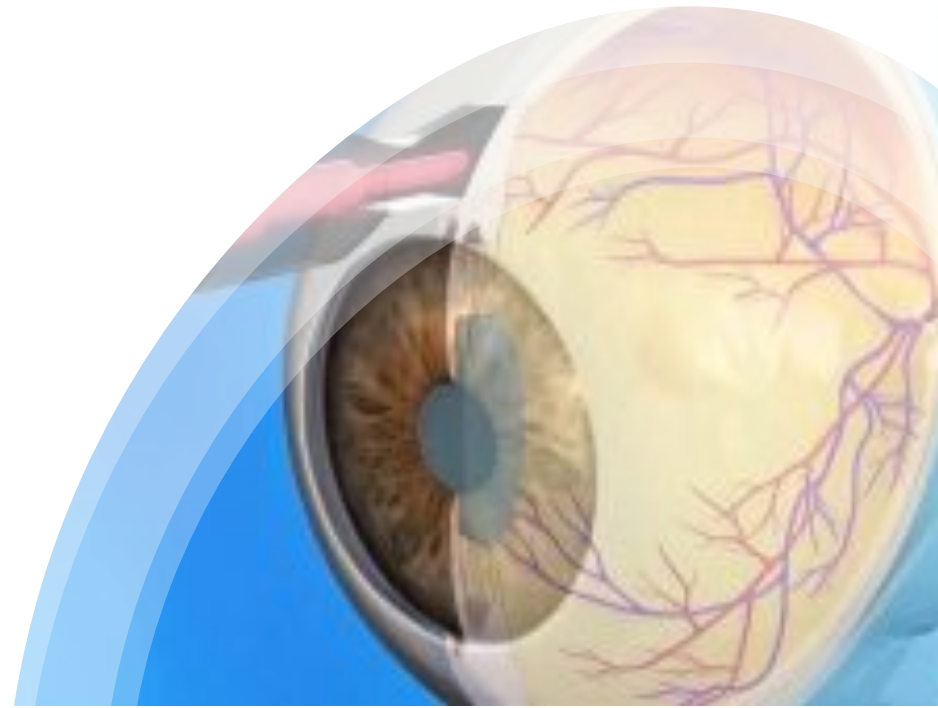


Diagram of laser iridotomy treatment on an eye

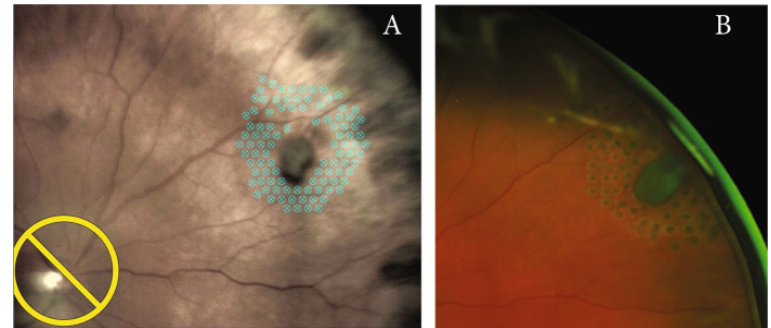
Retinal Disorders – Diabetic Retinopathy

- • Condition: Neovascularization from ischemic retina.
- • Treatment: Panretinal photocoagulation (PRP)
 - 1200–1600 burns in peripheral retina using Argon/Diode laser
 - Reduces VEGF → regression of abnormal vessels
- Side effect: Reduced night and peripheral vision, central vision preserved.



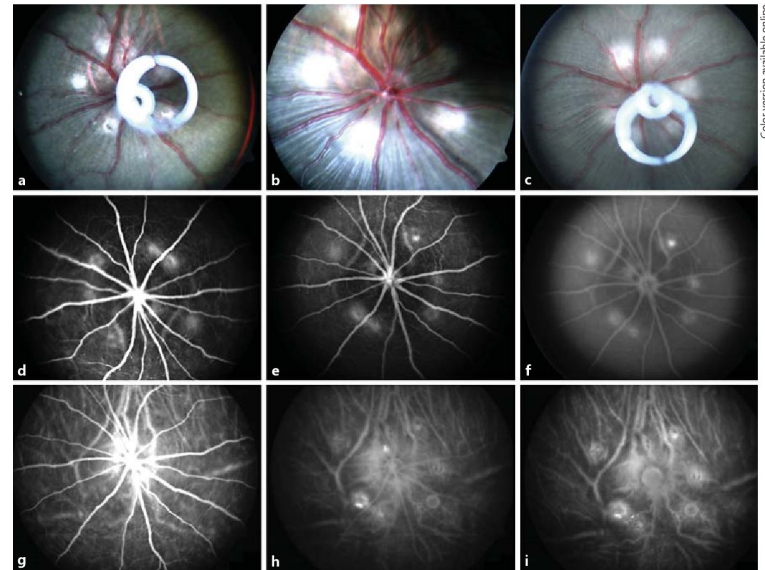
Retinal Disorders – Retinal Tears

- • Condition: Retinal break → risk of detachment.
- • Treatment: Laser Retinopexy
 - - Laser applied around tear edges
 - - Creates adhesion/scar that seals tear and prevents detachment
- Indications: Symptomatic tears, early detachments.



Retinal Disorders – Wet AMD

- • Condition: Choroidal neovascularization under macula → fluid leakage and bleeding.
- • Treatment: Photodynamic Therapy (PDT)
 - Verteporfin injection + diode laser (689 nm)
 - Drug activated only in abnormal vessels → closes them selectively
- Note: Anti-VEGF injections are now mainstay, PDT used selectively.



Corneal & Refractive Surgery – PRK

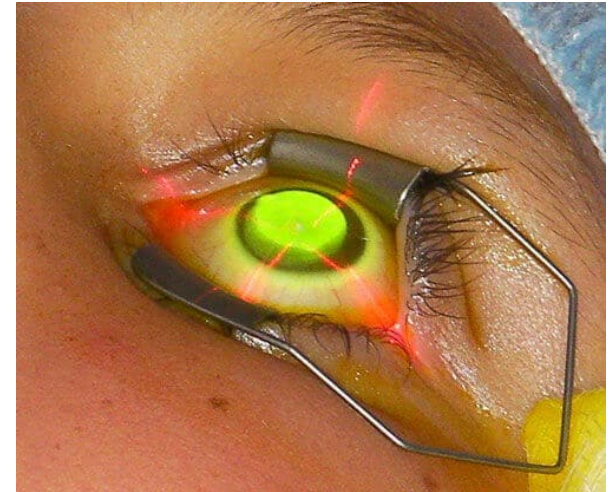
- • Procedure: Epithelium removed, Excimer laser reshapes corneal stroma.
- • Indications: Myopia, hyperopia, astigmatism.
- • Advantages: Simpler, no flap.
- • Disadvantages: Painful recovery, slower rehab, haze risk.

Corneal & Refractive Surgery – LASIK

- • Procedure: Femtosecond laser creates corneal flap.
- Excimer laser reshapes stroma, flap repositioned.
- • Advantages: Fast recovery, minimal discomfort.
- • Risks: Flap displacement, ectasia, dry eye.

Corneal & Refractive Surgery – SMILE & Keratoconus

- SMILE (Small Incision Lenticule Extraction):
 - - Femtosecond laser creates lenticule, removed via 2–3 mm incision.
 - - Stronger cornea, less dry eye.
- Keratoconus:
 - - Cross-linking (CXL): Riboflavin drops + UV-A strengthen collagen.
 - - Prevents progression.



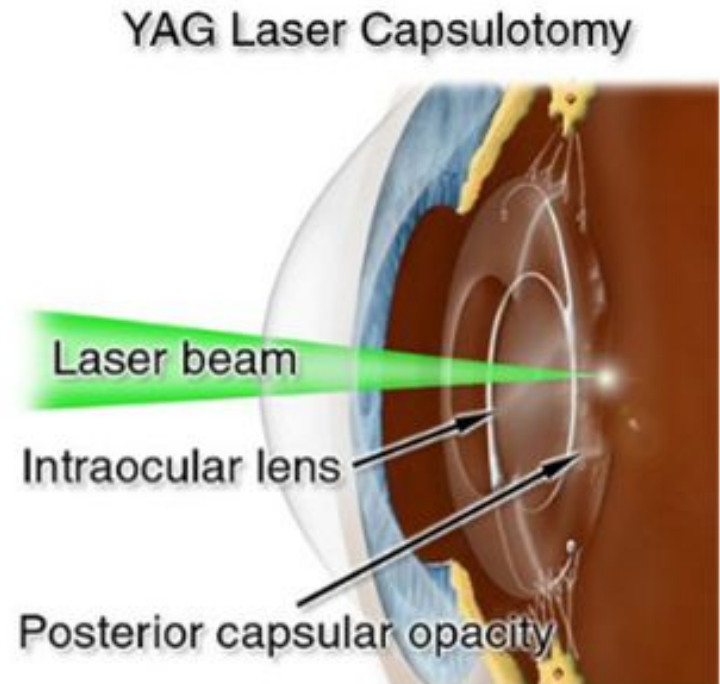
A small laser opening is made on the surface of your eye, a thin layer just below your eye's surface is removed.



A flap is made on the surface of your eye; a second laser reshapes your cornea

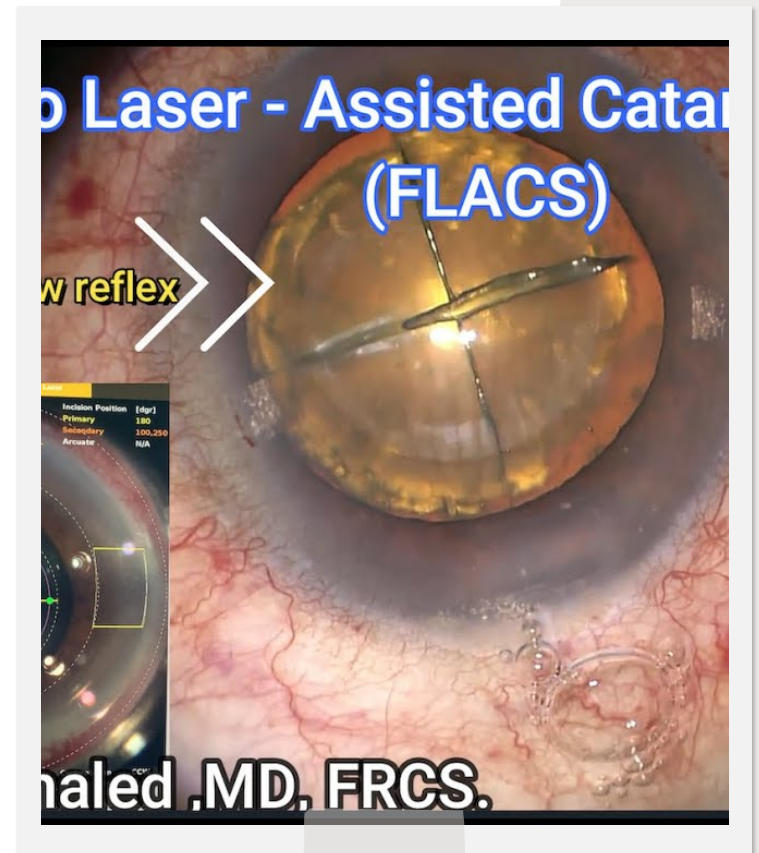
Cataract Surgery – PCO

- • Posterior Capsular Opacification (PCO):
 - - Common years after cataract extraction.
 - - Cloudy posterior capsule causes blurred vision.
- • Treatment: Nd:YAG capsulotomy.
 - - Shockwave laser creates central opening.
 - - Restores vision immediately.
- Risks: IOP rise, retinal detachment (rare).



Cataract Surgery – FLACS

- • Femtosecond Laser-Assisted Cataract Surgery (FLACS):
 - - Makes corneal incisions, capsulorhexis, pre-fragments lens.
- • Advantages: More precise, useful in weak zonules or small pupils.
- • Limitations: Expensive, not superior in routine cases.



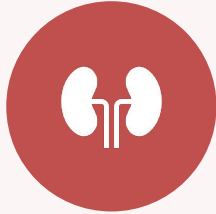
Advantages of Lasers

- • Minimally invasive, incisionless
- • Micron-level precision
- • Faster recovery
- • Tissue-specific targeting
- • Outpatient procedures

Limitations & Complications

- • Expensive equipment, requires training
- • Risks:
 - - Retinal burns, scarring
 - - Rise in IOP
 - - Visual field defects
 - - Corneal haze in refractive surgery

Case Study 1 – Diabetic Retinopathy



55-YEAR-OLD MALE,
15-YEAR DIABETES



• SYMPTOMS: BLURRED
VISION, FLOATERS



• EXAM:
NEOVASCULARIZATION,
ISCHEMIA



• DIAGNOSIS:
PROLIFERATIVE DR



• TREATMENT: PRP WITH
ARGON LASER



• OUTCOME:
NEOVASCULAR
REGRESSION, PRESERVED
CENTRAL VISION

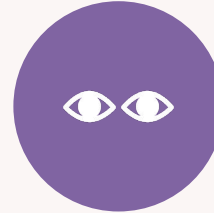
Case Study 2 – Acute Angle-Closure Glaucoma



60-YEAR-OLD FEMALE WITH
SUDDEN SEVERE PAIN,
HALOS, RED EYE, NAUSEA



- IOP: 50 MMHG, CORNEA
HAZY, SHALLOW AC



- DIAGNOSIS: ACUTE
ANGLE-CLOSURE
GLAUCOMA



- EMERGENCY:
IOP-LOWERING MEDS



- LASER: ND:YAG
PERIPHERAL IRIDOTOMY



- OUTCOME: IOP
NORMALIZED,
PROPHYLACTIC LPI IN
FELLOW EYE

Case Study 3 – Secondary Cataract



65-year-old male,
cataract surgery 2 yrs
ago



- Symptoms: gradual blurred vision



- Exam: Cloudy posterior capsule



- Diagnosis: PCO



- Laser: Nd:YAG capsulotomy



- Outcome: Immediate improvement, risks explained

MCQs – Practice

Q1. Which laser for capsulotomy?
(Ans: Nd:YAG)

Q2. PRP works by reducing? (Ans: VEGF)

Q3. Excimer wavelength?
(Ans: 193 nm)

Q4. Laser for AACG? (Ans: LPI)

Q5. PDT drug?
(Ans: Verteporfin)

Fill-in-the-Blank Practice



1. POSTERIOR
CAPSULOTOMY USES
_____ LASER. (ND:YAG)



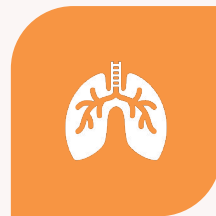
2. PRP REDUCES _____
PRODUCTION. (VEGF)



3. LPI CREATES OPENING IN
THE _____. (IRIS)



4. EXCIMER LASER
WAVELENGTH IS _____
NM. (193)



5. CROSS-LINKING USES
_____ DROPS.
(RIBOFLAVIN)