

Principles of Lasers in Glaucoma Treatment

By

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Glaucoma...

- Glaucoma represents a group of diseases defined by a characteristic optic neuropathy that is consistent with excavation and undermining of the neural and connective tissue elements of the optic disc and by the eventual development of distinctive patterns of visual dysfunction.

Background

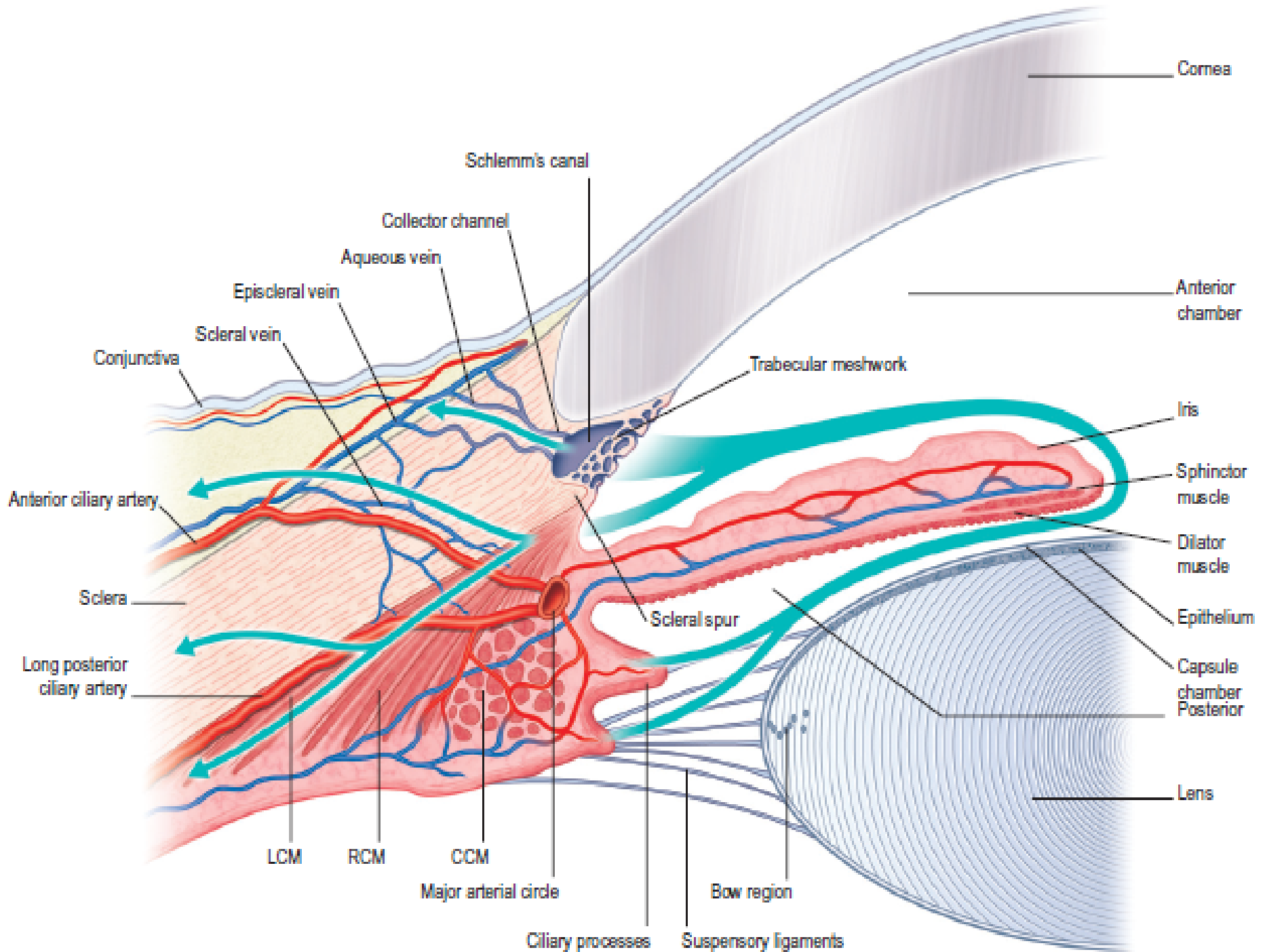
- **IOP**
 - is a very important risk factor for glaucoma
 - is the only modifiable risk factor
 - to slow down development & progression
- RCTs : CNTGS, AGIS (7), CIGTS, OHTS, EMGTS

Treatment goal.....

- **Lower intraocular pressure** - Target pressure
- **Slow progression of Optic Nerve damage**
- Preserve vision thus prevent blindness
- Prevent discomfort (painful eyes)
- **Maintain visual related quality of life**

Adequate lowering of IOP :

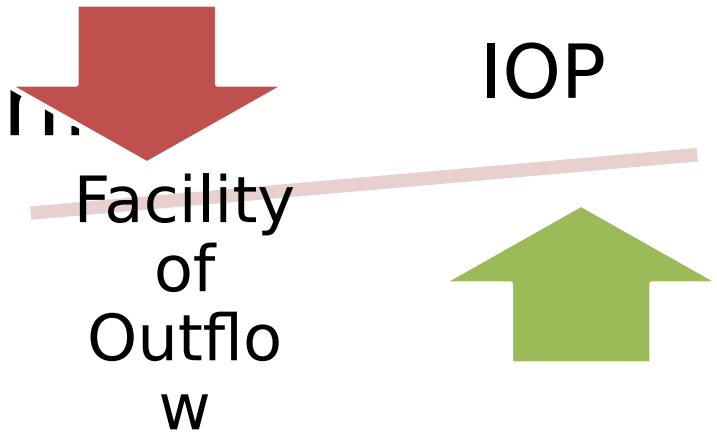
- reduces progressive loss of RGCs,
- reduces progression of optic cupping
- stabilizes VFDs.



Aqueous Dynamics

Goldmann's equation:

$$P_o = (F/C) + P_v$$



- where P_o is the IOP in millimeters of mercury (mm Hg),
- F is the rate of aqueous formation in $\mu\text{l} / \text{min}$
- C is the facility of outflow in $\mu\text{l} / \text{min} / \text{mmHg}$
- P_v is the episcleral venous pressure in mmHg
- Resistance to outflow (R) is the inverse of facility (C).

Types/Mechanisms of glaucoma treatment

Medic
al

AQ
Prod

AQ
Out
flow

Laser

AQ
Prod

AQ
Outflo
w

Surge
ry

AQ
Outflo
w

Ideal Glaucoma treatment

To the patient

1. Non invasive
2. Affordable
3. Acceptable
4. Available
5. Preserve vision
6. Affords pain relief where necessary
7. No follow up necessary

**DOES NOT
EXIST!!!**

To the physician

1. Easy to learn or teach
2. Once-off
3. Minimum outlay
4. Maintains IOP, no spikes
5. Minimum operating time
6. Preserve vision
7. Day case

Medical?

Laser??

Surgery???

Could Lasers be an answer in Nigeria?

Lasers have:

- Excellent safety profile
 - non-incisional, Non-invasive
 - downtime is significantly less
 - minimal or no inflammation
 - minimal post op topical Rx
- Efficient and straight forward
- Can be performed in office or OR
- Predictability
- Repeatability

Draw backs.....

- Availability
- Accessibility
- Affordability
- Baseline high IOP (Blacks)requiring multiple drug therapy for control =
Laser +
- Insufficient data in our environment

Types of Laser treatment in glaucoma

- Trabeculoplasty - Argon }
 - SLT } ----- Trab Meshwork/
AqD
 - MLT }
- Iridoplasty }
- Iridotomy } Iris..... AqD.
- Cyclo-photocoagulation - ND:YAG } ciliary body
 - Diode } = AqP
 - Diode - trans-scleral } - Conventional &
micropulse
 - Endoscopic CPC

Efficacy – How effective is Laser Trabeculoplasty?

Singh et al(2011)

- IOP typically lowered by 20-30% - in studies

<1year x - 75-85% of pts

> 5yrs x = 50%

>10yrs x = 32%

Efficacy:

AGIS 9:

- ALT was slightly more effective in blacks.

Glaucoma Laser Trial

- ALT more effective than Timolol

McIlraith *et al.* (2006)

- *initial SLT and latanoprost yielded similar outcomes: IOP reduction of 31% in 1 year*

Nagar *et al.* (2005)

- *initial 360 degree SLT and latanoprost - equally effective.*

Laser Trabeculoplasty

Features	ALT	SLT	MLT
1 st described	1979	1995	2005
By	Wise & Witter	Latina & Park	Ingvolstad et al
Laser Type/ wavelength used	Argon 488nm/514nm, 532	Nd: YAG - Q switched double 532nm	532nm,577nm
Spot size	550µm / 0.1 sec/ 40-50 applications	400µm/0.3ns/100 spots	300µm -small to access narrow angles
Mechanism of Action	<p>i. Thermal (coagulative) effect on TM ⇒ scars with stretching & widening of areas adjacent to the laser applic ⇒ ↑IOP drainage</p> <p>ii. Phagocytotic activity</p> <p>iii. DNA</p>	<p>1. Selective photolysis with marked absorption by Melanin pigment ⇒ ablating the pigment cells</p> <p>2. ii. Phagocytotic activity</p>	<p>i. Thermal effects</p> <p>No destruction of pigmented TM cells</p>

Laser Trabeculoplasty

Features	ALT	SLT	MLT
Area Covered at one sitting	180°	360°	360°
Treatment Endpoint	Blanching (mild) to bubbles (intense)	Small bubbles	No visible tissue Rxn
Repeatable	No	Yes	Yes
Post -op Inflamm	Yes	Yes	None
Indications	<ul style="list-style-type: none"> I. POAG II. PXFG III. Pig Glaucoma IV. As 1° therapy V. As adjunct 	<ul style="list-style-type: none"> i. POAG ii. PXFG iii. Pig Glaucoma iv. NTG v. OHTN vi. Prophylaxis for steroid induced Glauc. ff Intravitreal Triamcinolone vii. In severe OSD viii. Poor adherence 	Similar to SLT

Laser Peripheral Iridotomy (LPI)

Indications:

- **To prevent or treat pupillary block in:**
 - acute angle closure glaucoma (AACG),
 - fellow eye of a patient with AACG,
 - chronic angle closure glaucoma (CACG),
 - primary angle closure suspect (PACS)
 - miscellaneous conditions such as pigmentary dispersion syndrome, phacomorphic glaucoma, aqueous misdirection, nanophthalmos, and plateau iris syndrome.

Laser Peripheral iridotomy

- Laser Used : Argon & Nd:YAG
- Nd:YAG laser : is typically preferred
 - simpler to apply with fewer applications
 - more tolerable for patients.
 - uses less energy
 - lower closure rates

LPI

Argon LPI:

- less likely to cause hyphema (thermal & coagulative)
- preferred in pts on anticoagulant Rx or with visible iris vessels that are more prone to bleeding
- Uses high level of cumulative energy to create the iridotomy \Rightarrow causing more inflammation & corneal endothelium decompensation

In patients with dark and thick irides:

- Use a combination of argon and Nd:YAG laser
- or**
- pretreatment with 532 nm continuous-wave Nd:YAG laser were found useful to decrease the amount of energy needed for LPI
 - Disturbing visual symptoms such as diplopia, transient blurring, glare, shadows, lines and ghost images can occur if exposed

Laser Iridoplasty (LI)

- LI is the photocoagulative ablation to the peripheral iris
- The indications for LI included
 - plateau iris syndrome
 - angle closure in nanophthalmos
 - In preparation for laser trabeculoplasty when iridocorneal angle is narrow and difficult to visualize
 - AACG } \geq systemic & topical Rx
 - Phacomorphic glaucoma }

LI Procedure.....

- Instill a miotic
- Apply argon or diode laser spots to the iris periphery
- MOA - thermal energy causes contraction of the Iris stroma with widening of the angular recess
- With a single laser application, 85-90% of angles remained open for up to 10 years of follow-up

Laser Cyclophotocoagulation

Traditional use:

- Resistant glaucoma patients to medical or surgical Rx,
- Not suitable for medical & Surgical Rx
- Blind eye
- Eye pain due to end-stage diseases esp NVG

Laser Cyclophotocoagulation

- Changing indications
- Changing techniques
- Changing attitudes

Laser Cyclophotocoagulation

Changing Indications:

- As 1^o treatment in seeing eyes
- Adjunct to medical therapy
- Adjunct to surgical therapy
- Poor adherence/compliance
- Poor potential for follow-up
- OSD

Laser Cyclophotocoagulation

- **Types :**
 - ND-YAG
 - DIODE
- DIODE
 - Trans-scleral CPC
 - Endoscopic CPC

Laser

Cyclophotocoagulation

Mechanism Of Action :

- Coagulative destruction of the ciliary processes
 - ↓ Aqueous production
- TSCPC – No visualisation of CB
 - through Conj & Sclera
- Endoscopic – Direct visualization & application thru an endoscope & video monitor;
 - Entry through Pars-plana /limbus during cataract surgery etc

Laser Cyclophotocoagulation

- Pucci et al (2003)
- TSCPC IOP reduction:
 - a 35-45% IOP reduction
 - a 50% decreased need for pretreatment medications

.Results from Nigeria – Abdull....

Diode Laser CPC

- The Diode laser (810-nm) wavelength used today for transscleral diode photocoagulation (TCP) and endocyclophotocoagulation (ECP); causes a more targeted destruction of the melanin in the ciliary epithelium and less pain, discomfort, and inflammation.

Others.....

- Titanium Sapphire Laser
Trabeculoplasty (TLT)
- Pattern Scan Laser
(PASCAL) Trabeculoplasty (PLT)
- Nd:YAG laser goniopuncture
- Excimer laser trabeculotomy (ELT)
- Laser assisted deep sclerectomy

Conclusion....food for thought

Could Laser play a role in the control of
glaucoma

blindness in our environment?

Thank you !!!!