

Surgical options in glaucoma A-Z

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Disclosures

Outline

- A) Decision making involving choosing medical and surgery as the modality of treatment in managing glaucoma
- B) Types of drugs and groups and efficacy.
- C) Types of surgery
 - Laser
 - Trabeculectomy
 - Minimally penetrating glaucoma surgery
 - Drainage devices

To chop or to drop

- This debate has gone on for long time
- What should occur first?
 - Drop
 - Chop

Medications first advantages

- Drugs are safer than surgery-
 - Less complications
 - Less discomfort
- Drug effects can reversed or is short acting
- Less expensive in the short run
- Multiple drugs can be combined to achieve successful reduction in IOP
- Better quality of life when compared to surgery first (Lichter et al., Ophthalmology 2001)

Medications first disadvantages

- May be more expensive in the long run
- Multiple drugs
 - Compliance, adherence and persistence issues
- Chronic drug uses and its effect on future surgical outcomes?
 - Preservatives effect?
 - Inflammation leading to failure of future procedures*
- Increased chances of cataract formation

• *Broadway DC et al., Adverse effects of topical antiglaucoma medications: II Arch Ophthalmol 1994

Surgery first - advantages

- If successful and large drop in IOP may be obtained
- No issues related to patient compliance, adherence and persistence
- Good in situations where obtaining continuous supply of medications is a problem
- May be cheaper long term

Surgery first - disadvantages

- Outcomes may be variable
- Long term may lose efficacy
- May still require additional topical medications
- Complications may be dire
- Comfort and quality of life may be lower
- Chances of cataract formation is greater than topical medications
- Age- young vs. older individuals

Race and management options

- Race – white versus individuals with greater pigment
- Individuals with greater pigment- greater risk of post-operative scarring*
 - Medications –first choice

*Broadway DC et al., Racial differences in the results of glaucoma filtration surgery: are racial differences in conjunctival cell profile important? BJO 1994

Age and management options

- Younger individuals
 - Accelerated wound healing systems
 - Thick fleshy periocular tissues heals rapidly
- Thus older individuals better suited for surgical options

Overall mostly it is medications first!

When is surgery indicated?

Argon Laser Trabeculoplasty- (ALT) theory

- Enhances aqueous outflow
- How does it cause increase outflow
- Exact mechanism unknown
 - Mechanical theory
 - Mechanical tightening of trabecular meshwork
 - Opens adjacent untreated spaces
 - Laser induced cellular changes
 - Microphages migrate to the location
 - Clears trabecular debris

Argon Laser Trabeculoplasty- indications

- Open angle
- Require decrease in IOP
- Both POAG and secondary like pseudoexfoliation or pigmentary
- Poor candidates
 - Angle recession, uveitic glaucoma, aphakia, high IOP (35 or greater), high episcleral venous pressure
 - Very young individuals
 - Previous 360 degree ALT

Preoperative considerations

- Depends on status of disease
- Continue IOP lowering medications (if on it)
- If moderate loss or damage
 - Preoperative 1% apraclonidine or hyperosmotic agent
- Best performed undilated
 - Does not require pupil constriction either

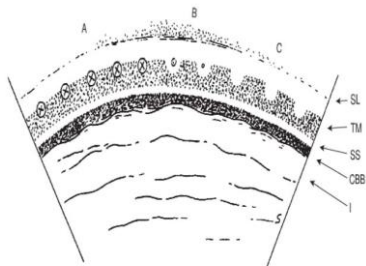
Procedure of ALT

- Anesthetic and gonioscens with coupling fluid
- Clear view is a must
- Ideal lens Ritch lens (good view, optics most suitable and least collateral damage)
- Recommended spot size is 50 micro meter and 0.1 second duration
- Power 0.5W to 1.0W
- Ideally tissue should blanch or small bubble should form

Procedure of ALT cont...2

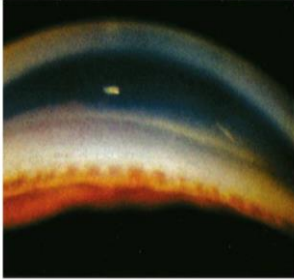
- **Eight (8) burns per clock hour**
- Location of burn- junction of non-pigmented and pigmented meshwork
- 50 burns per session (two sittings ideal)
- or 100 burns per 360 degrees of meshwork (that is total)

Placement laser burns



Shields textbook of glaucoma

Blanched lesions after ALT



Post-operative management

- Remain in office for 1 hour at least
- Monitor IOP
- 1% apraclonidine immediately after procedure
- Topical CAI or pilocarpine may be considered or oral hyperosmotic agents
- Steroid use for 4 days
 - Prednisolone acetate 1% 4 times a day for 4 days
- Continue IOP lowering medications if already on it
- Follow-up schedule 1,4 and 8 weeks (approx 2 months)

Outcome

- If IOP still high
- Consider doing other 180 degree if option (4 weeks later)

Summary of Argon Laser Trabeculoplasty

- Laser burns to trabecular meshwork
- Enhances aqueous flow and thus lowers IOP
- Usually an adjunct therapy
- Treatment benefit seen 4-6 weeks
- 180 degrees at a time, 360 can be done
- Retreatment not effective

Results of ALT

- POAG success rate 75-80%
 - Average reduction in IOP reduction is 30%
- 50% still controlled after 5 years
- Failure if occurred usually first year

- NTG success rate 50-70%
 - Absolute reduction in pressure not as good as POAG
- Pseudoexfoliation glaucoma
 - Excellent results
 - Not as good in other secondary glaucoma
 - Does not work in pediatric glaucoma

Selective Laser Trabeculoplasty (SLT)

ALT versus SLT

- Unlike ALT SLT does not scar
- Autopsy specimens – confirm no coagulative damage after SLT
- Ultrastructural measurements show
 - Crackling of intracytoplasmic pigment granules
 - Disruption of trabecular endothelial cells
- In-vitro studies pulsed laser
 - longer than 1 microsecond –non selective damage of pigmented cells
 - 10 nanosecond to <1 microsecond – no collateral damage

Mechanisms of action SLT

- 5-8 fold increase in monocytes and macrophages in TM
 - after treatment with SLT
- Hypothesis
 - Injury via laser causes releasing of chemoattractant
 - This in turn recruits monocytes that are transformed into macrophages
 - Macrophages clear pigment granules and exit via Schlemm’s canal

Alvarado and Murphy Outflow obstruction in pigmentary and primary open angle glaucoma Arch Ophthalmol 1992

Pre-operative considerations

- Alpha 2 agonists preoperative (Brimonidine or Apraclonidine)
 - Helps reduce post-operative spikes
- Untreated eyes- timolol may also work
- Topical anesthetic before procedure

SLT -procedure

- Frequency doubled Q-switched Nd:YAG laser
 - 532 nm
 - Pulse 3 nanosecond
 - Spot size 400 micro meter
- Beam focused over pigmented TM
- Standard therapy 50-100 adjacent non-overlapping spots over 180-360 degrees
- Power 0.8mJ (0.2 to 1.7mJ)
- Heavily pigmented eyes – lower power
- Endpoint- tiny “champagne” bubbles

Selective Laser trabeculoplasty

- Selectively targets melanin pigment of TM
- More safe compared to ALT (because lower power)
- Equally effective as ALT
- Can be repeated if first attempt is not effective

Post-operative considerations

- Anti-inflammatory medications –post SLT prophylaxis
 - NSAID or steroids
 - Does not give added benefit in lowering IOP
- No robust evidence in suggesting use or not to use anti-inflammatory agents post SLT

Video SLT

Video SLT heavy pigmentation

Peripheral iridotomy

Angle closure glaucoma

Indications

- Acute primary angle closure
 - One to two days after attack
 - Once eye is settled and edema is cleared
- Fellow eye of acute primary angle closure
 - 50% chance of angle closure
- Chronic angle closure
- Narrow or occludable angle

Contraindications

- Significant edema
 - Unable to visualize iris
- Thick iris
 - Dilated pupil, bunched up iris
- High risk of complications
 - Significant inflammation

Pre-operative considerations

- Avoid prostaglandins – can stimulate inflammation
- Immediately prior to procedure
 - 1% pilocarpine three times spaced over 10 minutes
 - Anesthetic gel before procedure
 - Prevents discomfort
 - One drop alpha 2 agonist 30 minutes prior and immediately after procedure
 - Decrease pressure spikes

Procedure of peripheral iridotomy

- Choose 11 or 1 o'clock position
- Start with iris crypt or other thin region
- Target size 500 micro meter in diameter (minimum 200 micrometer)

Post-operative management

- Drop of apraclonidine 1% immediately after
 - Prevents spike
 - Oral CAI if IOP higher than before
- Topical steroid 4 times a day/ 4 days
- Measure pressure 1-2 hours later
- If IOP same or lower- discharge
- See next day
- Perform gonioscopy to asses angle changes
- Life long follow-up as some may become chronic angle closure

Complications

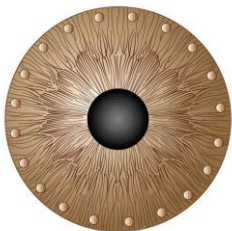
- Elevation of IOP – spike of IOP after procedure
- Accelerated cataract formation
- Some reports of delayed corneal decompensation
 - Angle closure related or may be laser related ?
 - Likely angle closure related
- Monocular blur, ghost images, shadows, glare

laser iridotomy video

Laser iridoplasty

- Procedure to open an appositionally closed angle
- Series of laser burns
 - Low power
 - Large spot
 - Longer duration
 - Extreme peripheral iris
- This causes tightening of peripheral iris creates a space between anterior iris surface and trabecular meshwork

Laser iridoplasty



Trabeculectomy

Pre-operative preparations

- Medications to stop (1-2 weeks) prior to surgery
 - Eg. Anticoagulants and nonsteroidal anti-inflammatory agents
- Evaluation of conjunctival health
 - Avoid area of previous surgery
 - History of topical medications

Normal conjunctival response to wound healing

- Classic features of acute inflammation
- Hemorrhage on site
 - Releases plasma proteins and blood cells
- Increase in local blood flow and vascular permeability
 - Additionally activation of migration of leukocytes
- Activated inflammatory cells
 - Secrete several cytokines and growth factors are secreted
 - Growth factors in turn recruit fibroblasts
 - This in turn leads to healing and scarring
 - In absence of further injury- apoptosis of t-lymphocytes and fibroblasts

Trabeculectomy

- Creates a fistula that allows aqueous from anterior chamber to subtenons space
- Fistula guarded by scleral flap
- The belb should not be fully vascularized neither completely avascular
- Mytomycin C (alkylating agent) or other antimetabolites (example 5-flurouracil) prevents scarring and failure

Trabeculectomy Video

Professor Peng Khaw (recently was knighted by the queen)

Glaucoma implants

- Indications
 - Uncontrolled glaucoma
 - Poor candidates for tabeculectomy
 - Neovascular glaucoma,
 - penetrating keratoplasty or retinal detachments with glaucoma
 - ICE syndromes traumatic glaucoma, previously failed trabeculectomy

Ahmed valve video

Minimally invasive or Micro invasive glaucoma surgery (MIGS)

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Ex-Press device

- Initially at limbus sub-conjunctivally
- Now implantation is under scleral flap



FIGURE 1 The Alcon EX-PRESS™ Glaucoma Filtration Device.

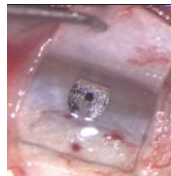
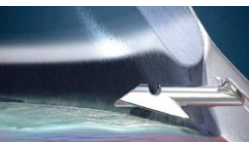
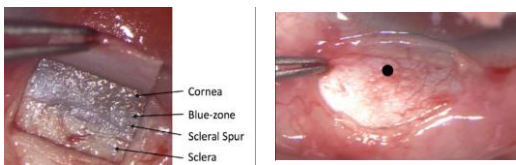
Basic design

- 27 gauge 0.4mm external diameter
- Tube length 2.4 to 3.0mm
- Internal diameter 50 to 200 microns
- The disc or flange prevents intraocular penetration
- Spur like projection lower external surface prevents extrusion



Main concepts Ex-Press

- Controlled aqueous humor flow -50-200 micron internal diameter provides some degree of control
- Trabeculectomy variations occur if sclerotomy performed manually or by a punch



Indications

- Open angle glaucoma
- Pigmentary and pseudoexfoliation syndrome
- Aphakic glaucoma
- Sturge-Weber syndrome
- Secondary uveitis
- Post trauma

Contraindications

- Relative
 - Congenital and juvenile
 - Anterior segment dysgenesis
 - Aniridia
 - Narrow angle
 - AC/IOL and glaucoma
 - Neovascular glaucoma
- Absolute
 - Narrow angle in young patient

Ex-Press

Advantages

- Safer than trabeculectomy
- Failure rate may be lower than Trab in theory??
- More controlled filtration lesser chance of hypotony??

Disadvantages

- More expensive
- Potential to block in future
- Black versus white race differences

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ORIGINAL ARTICLE

Long-term comparison using Ex-PRESS glaucoma shunt in black and white patients

Jeffrey Freedman, MBBCh, PhD, Sara Ferri, MD

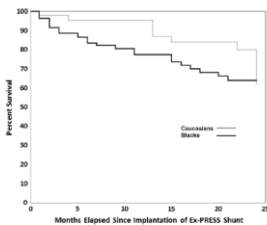
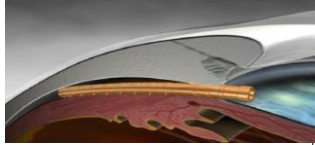


Fig. 1—Kaplan-Meier survival analysis among black and white patients who received the Ex-PRESS shunt glaucoma implant (Alcon).

Can J Ophthalmol 2014;49:200-204

Suprachoroidal outflow

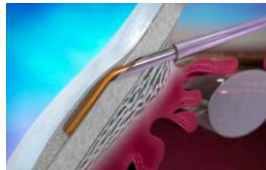
- Gold Micro Shunt
- CyPass
- Aquashunt



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Subconjunctival outflow

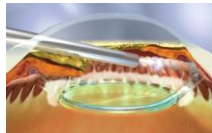
- XEN Gel Stent
- 6mm crosslinked gelatin
- 3 lumen sizes



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Endoscopic photocoagulation

- Direct tissue visualization-ciliary process



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Ex-Press implant

Canaloplasty Video

IOP lowering after Canaloplasty

- Dilating schlems canal is not enough
- Viscoelastic material does not remain too long
- Cannulation disrupts
 - Lateral walls, inner endothelium and bridging structure of Schlems Canal (SC)
 - These disruptions extend into Juxtacanalicular trabecular meshwork (JCT) and probably trabecular meshwork itself
 - Thus may cause direct connection between JCT and SC

Case 1 SLT in a non compliant patient

- 62YO female, White
- Vn 20/40 OU with Rx
- No APD.
- SLE – unremarkable
- Suspicious nerves
- Referred for evaluation

October 2012

- 20/40 OU

No improvement with PH or change of refraction

- APD

- SLE 2 + ns

- IOP OD 16 and OS 18 mmHg 10.26 AM

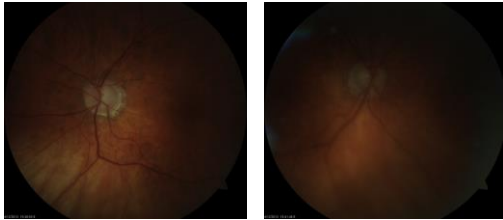


- Referred back to optometrist with suggestion that need to establish IOP baseline and then start treatment.
- Patient came back on December 2013
- 20/30 OD and 20/50 OS
- Had not followed back with the referring practice
- Had visited an ophthalmologist in April 2013 who had given Latanoprost, did not like the meds.
- IOP OD 17 OS 19 mmHg at 11 AM

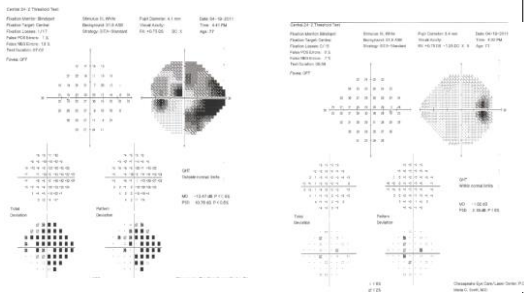
- Nerve OS slightly greater cupping than OD.
- Referred to an ophthalmologist for SLT
- Patient does not like any form of meds, will not take meds.

- Case where IOP too high for type of nerve
- 79 WF
 - Patient recently moved to CA, did not like the doctor in CA wanted another
 - BP
 - VN
 - 20/50 OD
 - 20/30 OS
 - Negative APD
 - IOP 21 OD 20 OS at 2.20 PM

- ONH
- OD 0.75h0.8 v pale disc, does not follow ISNT, shallow cupping
- OS 0.8 V and H
- Meds recently changed by CA doctor
- Timolol qam and latanoprost qhs
- For years she was on Timolol BID and Xalatan qhs reports good control in IOP



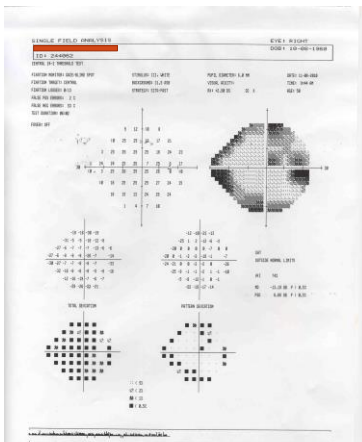
VF at previous doctor



- Switch back to timolol BID and Xalatan
- Follow –up visit May 2013
- Reports compliant to meds
- IOP 26 mmHg OD, 20 mmHg OS at 1.39 PM
- IOP too high for the nerve was referred for evaluation of surgery
- First SLT was performed and IOP not lowered successfully Trabeculectomy/ ExPress implant considered.

Case 3

- 50YO BF
- Vn 20/40- and LP OS
- No improvement with PH
- Slitlamp
- OD cortical cataract
- OSTotal traumatic cataract
- IOP 23 OD 28 OS
- Gonioscopy –Open angle CBB all quadrants OU
 - ✦ TM pigmentation even 360 degree grade 2



VF 24-2

- Rx Travatan Z qhs
- RTC 1 month

- 1 month later – IOP OU 26 mmHg
- Non compliant- discussed importance of IOP lowering
- RTC 1 month

- 1 month later IOP OU 26 mmHg- reported non compliance due to family visit
- Educated and RTC 1 month

- Visit 4
- Reported compliant to medications
- IOP
- OD 15 mmg (11 mmHg lower than highest)
- OS 16 mmHg (12 mmHg lower than highest)

- RTC 3-6 months
- IOP recheck, VF 24-2
- Discussion- compliance important, rechecks important, Laser an option in non-compliant patients.

- Case 4
- 2009
 - Painful eye OS intermittent 1 year, nothing helps
 - Vn OD 20/40
 - OS NLP

 - Slitlamp
 - OD NS 2+
 - OS corneal edema, iris neo

 - IOP OD 24 mmHg, OS 61-74 mmHg

- Tx
- In office Iopidine, timolol, acetazolamide 250 mg 2 tabs
 - Side line point 500 mg STAT and then BID
- IOP lowered to 53 mmHg OS

- CD OD 0.75 H/V 0.85
- Macula soft drusen OD
- OS no view

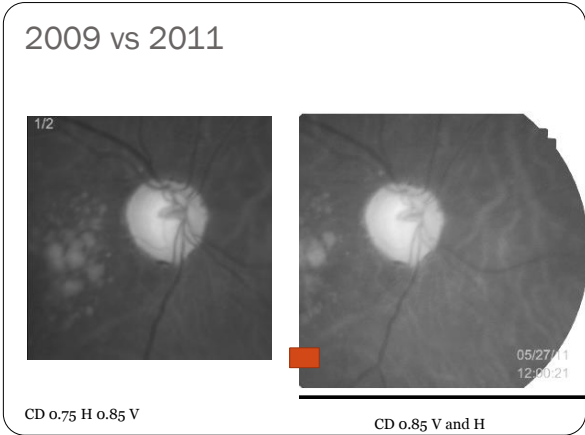
- Plan- Px referred
- OD Xalatan qhs, timolol BID
- OS Timolol BID and report to ophthalmologist for further management.

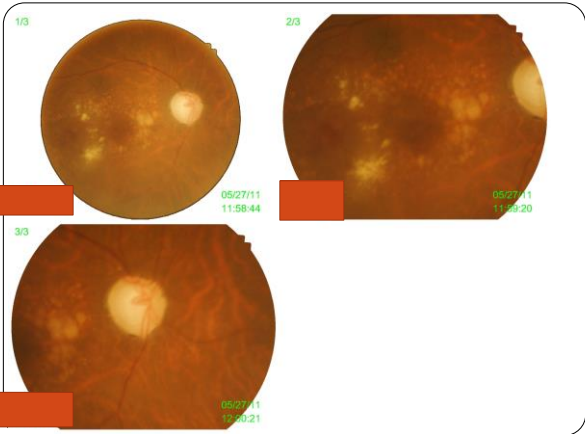
- 2 years later...

- 2011
- No new complaints. Stopped all medications 2 years
 - Not sure why?
 - OD 20/70 OS NLP (no pain)
 - Slit lamp
 - OD OS
 - Nuclear sclerosis Corneal edema, Iris neo
 - Cortical cataract
 - PSC

 - IOP 18 mmHg OD

- Fundus evaluation
- Clinically significant diabetic macular edema
- Diabetic retinopathy
- HTN retinopathy





- Re-educated on importance of medications.
- Due to non –compliance and monocular – referred for surgical consult
- Surgeons opinion was to opt for laser as first choice and trabeculectomy if laser treatment not successful.
