Optometric Surgical Procedures

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Paul Karpecki, OD, FAAO has relevant financial relationships with the following ineligible companies. All relevant relationships have been mitigated.

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Mallinckrodt	Honorarium/Speakers Bureau

Mar 7, 2026

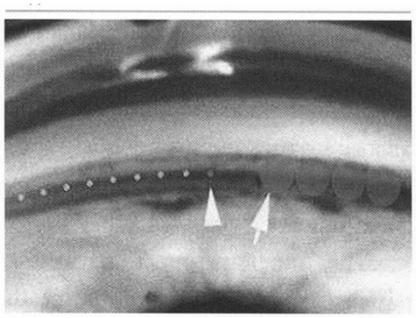
Outline: Glaucoma Lasers: What's New?

- Background on Ophthalmic Lasers in Glaucoma
  - ALT
  - SLT
- Evolution of Lasers in Glaucoma
  - Initially was for uncontrolled glaucoma, or failed medical therapy
  - One time application with ALT
  - When SLT became approved, most used it as third or fourth line
    - IOP reductions didn't seem all that great as used late in the line
    - Many questioned if SLT worked if a patient was on or had been on a PGA
  - Some questioned if it worked after cat sx
- Most trials before 2010 showed mixed results and poor study design

Outline: Glaucoma Lasers: What's New

- LIGHT Trial
- COAST Trial
- Direct SLT

Gonioscopy view of ALT/SLT



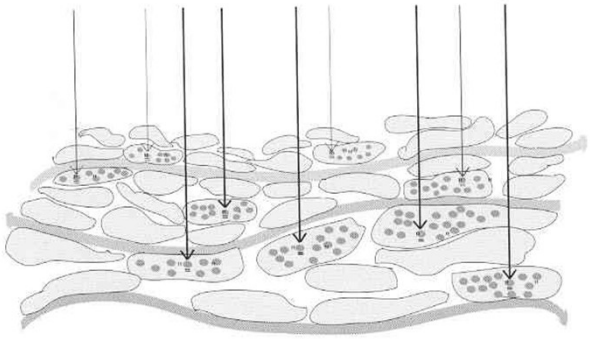
ALT (small dots) → photocoagulation; SLT (large dots) → biochemical response w/o thermal damage

Karmel, 2002

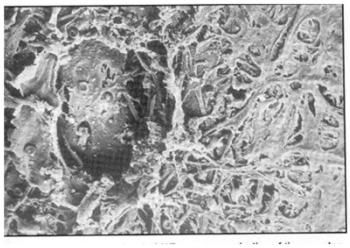
Selective Laser Trabeculoplasty
(SLT)

- 400 um spot size
- 3.0 nsec duration compared to 0.1 msec ALT
- Necrosis-induced phagocytosis of debris at the spot of the burn
- No visible tissue response on TM during procedure
- Destroys melanosomes of pigmented TM cells
- Sparing adjacent non-pigmented cells and tissues

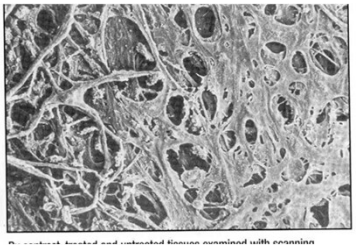
SLT: Selectively targets pigmented TM cells



ALT vs. SLT



High energy level -> vaporizes tissue water → forms TM crater



SLT: Treated/Untreated TM looks similar

Alvarado, 2002

SLT General Considerations

- -Energy levels. Champagne bubbles . 8 1.0 mj.
- -Target selections. 400 micron. Spot size. Paint entire mesh work
- -Placement of lens. Quicker with assistance less bubbles. GonioVisc/Sol vs Celluvisc
- -Treatment regimen: 360 degrees per session.

Pre-Op

- Basic exam components
  - VA, IOP, etc.
- Gonioscopy
  - Assess angle structure
  - Assess pigmentation
- 1 gt Iopidine or Alphagan
- Pilo 1% if need to pull iris out of angle to better visualize TM for treatment

SLT Gonio Lenses

Clinical Ophthalmology

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Incidence of Conjunctivitis and Keratitis with Reusable Ophthalmic Laser Lenses at an Academic Medical Center

Isabella V Wagner[1], Kannan Sharma[2], Cheryl L Khanna[3], Michael W Stewart[1], Adam B Snowden[4], P Connor Lentz[5], Yazan Abubaker[1], Pranav Vasu[6], Abhimanyu S Ahuja[7], Richard D Ten Hulzen[1], Syril K Dorairaj[1], Darby D Miller[1]

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Purpose: To determine the incidence of keratitis and conjunctivitis associated with reusable contact lens use during ophthalmic laser procedures at an academic medical center.

Patients and Methods: All laser procedures were performed at a single nonprofit academic medical center (Jacksonville, FL, USA). Data from patients that underwent neodymium-doped yttrium-aluminum-garnet (Nd:YAG) capsulotomy or selective laser trabeculoplasty (SLT) with reusable contact lenses between 2014 and 2023 was analyzed retrospectively. The post-procedure infection rate, defined as the incidence of newly diagnosed superficial keratitis and/or conjunctivitis within two weeks of the laser procedure, was calculated by dividing the total number of affected eyes by the total cohort size. A break-even analysis was conducted to evaluate the economic impact of reusable lens implementation.

Results: A total of 2285 eyes of 1363 patients were included in this study. The incidence of previous conjunctivitis in this cohort was small (0.4%) and no eyes had a prior history of keratitis. Of the 1372 Nd:YAG capsulotomy and 913 SLT procedures performed, only one eye (0.044%) developed signs of post-operative conjunctivitis and none developed keratitis. The single case of unilateral conjunctivitis occurred within one day of a Nd:YAG capsulotomy and was secondary to medicamentosa. A cost analysis showed that reusable ophthalmic laser lenses become more cost-effective than disposable lenses after approximately 86 SLT procedures and 91 Nd:YAG capsulotomies, while reducing medical waste by 79%.

Conclusion: Given the negligible rate of conjunctivitis, substantial cost savings, and significant reduction in environmental waste associated with reusable capsulotomy and trabeculoplasty lenses, the routine use of disposable ophthalmic lenses should be reconsidered.

Keywords: reusable ophthalmic lenses, Nd:YAG laser capsulotomy, selective laser trabeculoplasty

Procedure Technique

- Insert gonio lens (cushioning solution)
- Visualize angle
- Establish a system when performing these procedures and always do it the same (i.e. start at 6 and rotate clockwise)
- Before rotation lens identify a landmark

Procedure Technique

- Recommended initial power setting
  0.8 – 1.0 mj (won't need to go more than1.1 or 1.2 – go up in very small increments if needed)
- Desired tissue response will be subtle to see – a slight change in the surface of the TM is adequate treatment
- A small amount of bubble every few pulses appropriate
- Goal of 100 non overlapping spots over 360 degrees

Procedure Technique

- If patient had PDS – you may want to only treat 180° of one eye initially
- Have seen cases of IOP increase in PDS patients due to excess pigment = extra inflammatory response
- Some are treating only 180° then wait for to see what response is obtained
- Rule of thumb is more pigment use less energy still applies with SLT

Post-Op

- Check IOP 30 – 45 minutes after procedure
- If any increase second drop of Iopidine or Alphagan
- Pred Acetate qid– 5 days
- RTC one week – some are not having patient return at one week

ORIGINAL STUDY

Effect of Anti-Inflammatory Regimen on Selective Laser Trabeculoplasty Outcomes: A Randomized Controlled Trial

Juliana F. Miranda, MD, Heloísa A. Maestrini, MD, PhD,† Carolinne C.P. Barbosa, MD,† Laura Oltramari, MD,* Guilherme B. Guedes, MD,‡ Marcelo M. Nascimento, MD, PhD,§ Tiago S. Prata, MD, PhD,‖¶ Carla N. Urata, MD,* and Ricardo Y. Abe, MD, PhD*#*

Précis: Patients in the prednisolone acetate 1% group post-SLT had higher treatment success rates comparing with other anti-inflammatory drugs.

Purpose: To investigate the effect of different anti-inflammatory regimens on selective laser trabeculoplasty (SLT) outcomes.

Patients and Methods: A prospective randomized controlled trial. We included newly diagnosed primary open angle glaucoma POAG patients, we found higher success rates in patients treated with prednisolone acetate 1% after SLT. In addition, higher baseline IOP appears to positively influence postoperative outcomes.

Key Words: lasers, glaucoma, anti-inflammatory, glaucoma open angle, corticosteroid

(*J Glaucoma* 2025;34:421–427)

TABLE 3. Kaplan-Meier Survival Estimates After Selective Laser Trabeculoplasty Across Groups

	Prednisolone 1% (48 subjects)		Prednisolone 0.12% (44 subjects)		Ketorolac 0.5% (42 subjects)		
Time	**Censored**	**Survival probability, n (%)**	**Censored**	**Survival probability, n (%)**	**Censored**	**Survival probability, n (%)**	***P***
1 mo	0	100	0	97.7	0	100	0.855
3 mo	3	100	1	90.9	4	95.2	0.029
6 mo	3	93.3	5	72.2	6	74.0	0.550
9 mo	0	90.9	0	69.7	0	70.0	0.623
12 mo	35	83.7	23	63.9	13	67.0	0.003

In summary, this randomized controlled trial investigated the effect of 3 different anti-inflammatory drugs post-SLT (prednisolone acetate 1%, prednisolone acetate 0.12%, and ketorolac tromethamine 0.5%) in treatment-naïve newly diagnosed POAG patients. As SLT is becoming increasingly common as first-line therapy for ocular hypertension and POAG, it is important to investigate the use of which postlaser eyedrops could eventually interfere in success rates of the procedure. We showed that, even though the absolute percentage difference in IOP between the 3 groups did not reach statistical significance, we found that patients in the prednisolone acetate 1% group had better survival rates comparing with other anti-inflammatory drugs after SLT.

Continued SLT Considerations

- Final treatment discussion:
- What to expect:
- Long term effectiveness:
- Multiple use discussion on exit:
- First line treatment?
- Medication compliance?
- Medication cost?
- Pigmentation decrease energy
- Use of gonioscopy increases SLT skill

Early Clinical Trials SLT

- Latina et al., 1998 Ophthalmol
- 70% response rate
- Avg decrease in IOP= 23.5% or5.8 mmHg
- Works well in previous ALT patients without causing IOP spikes

Procedure Billing

- 65855 – SLT/ALT code
- 10 day global period
- National average for reimbursement is approximately $316 per eye
- Kentucky allowable is $288.09

Introduction

- Glaucoma has an adverse effect on Health Related Quality of Life due to[3,4]
  - Progressive loss of field of vision
  - Inconvenience of eye drops
  - Side effects of eye drops
  - Cost of mediations

3. Medeiros FA et al. Longitudinal changes in quality of life and rates of progressive visual field loss in glaucoma patients. Ophthalmology. 2015;122:293-301
4. Nordmann JP et al. Vision related quality of life and topical glaucoma treatment side effects. Health Qual Life Outcomes. 2003;1:75.

Selective Laser Trabeculoplasty versus eye drops for first-line treatment of ocular hypertension and glaucoma

- United Kingdom study set in 6 hospitals
  - Recruited patients from 2012-2014
  - Observer masked
  - Randomized
  - Treatment naïve patients/newly diagnosed OAG
    - No previous IOP lowering drops, laser or surgery

LIGHT Study Design

- 718 patients entered the study (1235 eyes)
- Patients randomized on a 1:1 basis to either:
  - SLT (356 patients, 613 eyes)
  - Drops (362 patients, 622 eyes)

Entrance Criteria

- For OAG
  - MD not worse than -12dB in the better eye
  - MD not worse than -15dB in the worse eye
- Visual acuity of 6/36 or better in treated eyes
- NO previous intraocular surgery
  - Except uncomplicated phacoemulsification at least 1 year prior to randomization into the trial
- Other exclusions:
  - Contraindication to SLT
  - Unable to use eye drops
  - Symptomatic cataract
  - Active treatment for some other type of ocular condition

Target IOP's in the LIGHT Study

- Based on Canadian Target IOP workshop
  - Disease stratification Mild, Moderate, or Severe
- Target IOP determined by both a % from a single untreated baseline measurement and an absolute threshold
  - Either 20 or 30% based on patient's clinical characteristics

Progression or Deterioration of Glaucoma During LIGHT Study

- Looking for progression of glaucoma OR conversion of OHT to OAG during the study
  - Impact on treatment escalations
- Decisions derived from the decision support software
  - Primarily based on HVF and HRT data
  - Verified by a consultant ophthalmologist for progression
  - Decide if it is "likely progression" or "possible progression"

Treatment Escalations in the LIGHT Study

- Based on guidelines from multiple international glaucoma and eyecare societies including AAO
- Treatment escalated IF:
  - There is strong evidence of progression irrespective of IOP level
  - IOP above target by more than 4 mmHg at a single visit
  - IOP above target by less than 4 mmHg and less strong evidence of progression…(possible progression)
- Additional 20% IOP reduction was then the goal if treatment escalated

SLT Laser Standardization

- Protocol defined settings and endpoints
  - 360 degree treatment
  - 100 non-overlapping spots
    - Approximately 25 per quadrant
  - Power could range from 0.3-1.4 mJ
- One re-treatment with SLT was allowed if IOP reduction was obtained with the first SLT
  - If there was and AE (IOP spike) then repeat was precluded
- After that the next escalation was medical therapy (drops)

Topical Medication Algorithm

- Drug classes for 1st, 2nd, and 3d line treatment were determined by the NICE guidelines[5]
- First line-PGA's
- Second line- Beta Blockers
- Third line- TCAI or Alpha Agonist
- Fixed combinations were allowed
- MMT=Clinician judged max most intensive combination of medicines that could be tolerated

5. National Institute of Health and Clinical Excellence. DoH; 2010. NICE: Guidance on Glaucoma: Diagnosis and management of chronic open angle glaucoma and ocular hypertension.

Outcome Measures

- Primary outcome
  - Health-related quality of life (HRQoL) at 3 years
    - Assessed by the EQ-5D
    - Recently this measure has come under scrutiny as to its ability to find differences in HRQoL in a short time frame like this study (3 years)
    - Glaucoma is largely asymptomatic even at levels sufficient to make driving unsafe
    - In this study, baseline HRQoL were above average
    - Unlikely that EQ-5D is sufficient tool to see meaningful data

Secondary Outcomes

- Cost and Cost effectiveness
- Glaucoma disease specific HRQoL
- Clinical effectiveness of SLT vs. Drops
- Safety of SLT vs. Drops

Results

- Overall 509 (95%) of 536 SLT treated eyes were at target IOP @ 3 years
- Target IOP achieved without medication in 419 (78.2%) of 536 eyes treated in SLT arm
  - 321 eyes (76.6%) required only one SLT session

Results

- 499 (93.1%) of the 526 eyes treated medically were at target IOP @ 3 years
  - 346 (64.6%) were using a single medication
- At 3 years:
  - 94.0% of visits were at target IOP for SLT group
  - 93.1% of visits were at target IOP for med group

Treatment Escalations and Progression of Disease During Study

- More treatment escalations occurred in the SLT group (348 eyes) than the Medication group (299 eyes)
- Progression
  - 36 eyes in the Medication group showed algorithm-confirmed progression
    - 3 eyes converted from OHT to OAG
    - 33 eyes with OAG progressed
  - 23 eyes in the SLT group
    - 2 eyes converted from OHT to OAG
    - 21 eyes with OAG progressed
- 11 eyes (1.8%) in the Medication group required incisional glaucoma surgery
  - NO EYES IN SLT GROUP REQUIRED INCISIONAL SURGERY

Adverse Events

- SLT Group
  - 6 eyes had an IOP rise of 5mm Hg or more on day of treatment
    - Only 1 eye required treatment
  - 122 eyes (34.4%) had transient discomfort, blurred vision or photophobia not requiring treatment
- Medication Group
  - 150 eyes had aesthetic side effects or allergic reactions

Cost of Therapy

- Eye drops were approximately double the cost effect of SLT
- Difficult to extrapolate to US market but general financial math should apply
- Eventual ophthalmic surgery (trab, tube, cataract etc) over the 3 years was significantly less in the SLT group compared to the Medication group

Primary Outcome Measure

- Primary outcome
  - Health-related quality of life (HRQoL) at 3 years
    - Assessed by the EQ-5D
- Small trend towards better HRQoL for SLT group vs. Medication group but not statistically significant
  - Recently this measure has come under scrutiny as to its ability to find differences in HRQoL in a short time frame like this study (3 years)
  - Glaucoma is largely asymptomatic even at levels sufficient to make driving unsafe
  - In this study, baseline HRQoL were above average
  - Unlikely that EQ-5D is sufficient tool to see meaningful data

Secondary Outcome Measures

- Cost and Cost effectiveness
- Clinical effectiveness of SLT vs. Drops
- Safety of SLT vs. Drops

Cost and Cost Effectiveness

- SLT as first line resulted in a significant cost savings relative to surgery and medication
  - Approximately 451 dollars/pounds savings in provider related visit costs per patient
  - For every patient given SLT in lieu of drops, the cost savings are greater than the cost of SLT for **2 additional patients!**
  - This is also equal to the cost of five additional office visits

Clinical effectiveness of SLT vs. Drops

- Rate of Disease Progression
  - In the Medication group 36 patients (5.8%) had disease progression
  - In the SLT group 23 patients (3.8%) had disease progression
    - 74% remained drop free at 3 years

Clinical effectiveness of SLT vs. Drops

- IOP Control
  - SLT first approach provided better IOP control over 3 years with more visits at target IOP compared to drops
    - Less intense drop treatment than Medication group
    - NO glaucoma surgeries required compared to Medication group
  - Could be due to adherence with SLT vs. Drops

Clinical effectiveness of SLT vs. Drops

- IOP Control
  - SLT provides better diurnal IOP stability[6]
    - Could be due to continuous effect on TM versus episodic administration of medication
  - Primary SLT afforded drop free control of IOP for 3 years in 74.2% of patients
    - This is much higher than in previous studies with less stringent success criteria
    - Prior treatment and more severe disease likely reduce the effect of SLT in those patients[7]
    - Likely the reason for such a robust response in treatment naïve patients in this study

6. Greenidge KC et al. Effect of argon laser trabeculoplasty on the glaucomatous diurnal curve. Ophthalmology. 1983;90:800-804
7. Nagar M et al. A randomized, prospective study comparing selective laser trabeculoplasty with latanoprost for the control of intraocular pressure in ocular hypertension and open angle glaucoma. Br J Ophthalmol. 2005:89:1413-1417.

Safety of SLT vs. Drops

- This study showed a greater safety profile of SLT than previously reported
  - No systemic side effects reported
  - Only 1 eye had an IOP spike
    - Compared to previously reported rates of 28.8%[8]
    - 2-week IOP checks did not change management for any patient and appears to be unnecessary
      - Avoidance of this could save more $ to the system
  - Lower rate of cataract surgery in SLT arm which supports the existing evidence of drops increasing incidence of cataract and surgery[9]

8. Wong et al. Systematic review and meta-analysis on the efficacy of selective laser trabeculoplasty in open-angle glaucoma. Surv Ophthalmol. 2015;60:348-59.
9. Heijl A, et al. Reduction of intraocular pressure and glaucoma progression: results from the Early Manifest Glaucoma Trial. Arch Opthalmol. 2002;120:1268-1279

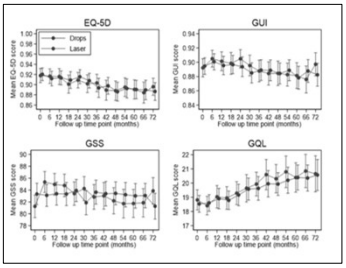
Conclusions

- Selective laser trabeculoplasty provides superior IOP stability to drops, at a lower cost AND
  - 74% or ¾ of patients are successfully controlled without drops for at least 3 years after a single treatment

B

LiGHT: SIX-YEAR STUDY UPDATE

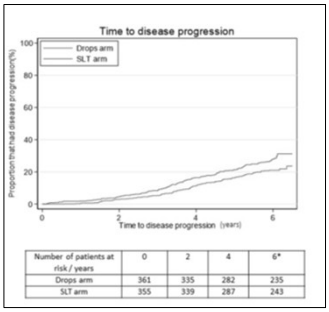
- 633 subjects entered 3-year extension study
- At the beginning of 3-year extension (month 37)
  - SLT: 313
    - 128 received SLT to decrease drop burden, 48 received SLT as treatment escalation
  - Medication: 320
  - QOL scores still non statistically significant



Gazzard G et al. Ophthalmology. 2023;130(2):139-151.

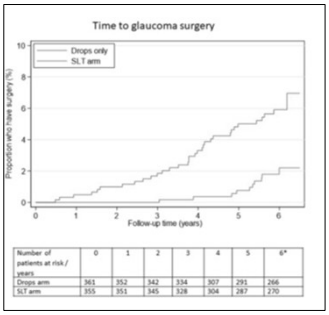
B

LiGHT: SIX-YEAR STUDY



% progression
- SLT: 19.6
- Med: 26.8

SLT More drop free:
70% vs. 18%



% glaucoma surgery
- SLT: 2.4%
- Med: 5.8%

Gazzard G et al. Ophthalmology. 2023;130(2):139-151.

LiGHT trial: 6-year results of primary selective laser trabeculoplasty versus eye drops for the treatment of glaucoma and ocular hypertension

Gus Gazzard, Evgenia Konstantakopoulou, David Garway-Heath, Mariam Adeleke, Victoria Vickerstaff, Gareth Ambler, Rachael Hunter, Catey Bunce, Neil Nathwani, Keith Barton, on behalf of the LiGHT Trial Study Group

Primary Outcome - Quality of Life at 6 years
Secondary Outcome – clinical effectiveness and safety

Conclusions:

- No significant difference in QOL
- 26.8% VS 19.6% progressed drops vs SLT
- Trab required in 32 eyes in drops arm compared to 13 eyes in the SLT arm
- 69.8% of SLT Drop Free @ 6 Years

M

What's New in SLT

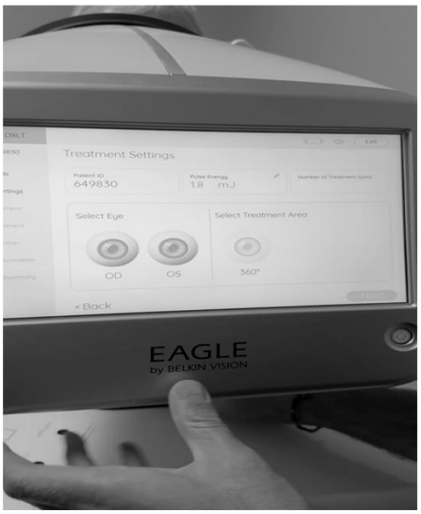
- FDA Approves Belkin's EAGLE DSLT December 2023.
- Direct selective laser trabeculoplasty (DSLT)-VOYAGER
- Noncontact SLT, 120 automated shots to limbal area
  - DSLT vs. SLT (30 subjects)
  - 1-year IOP reduction
    - DSLT: 21%
    - SLT: 33%

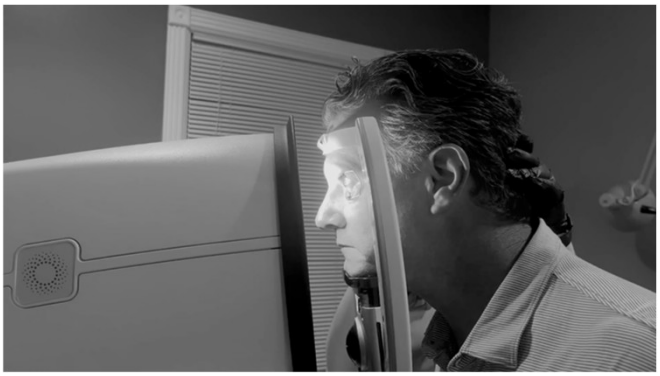
Geffen N et al. *Journal of Glaucoma*. 2017;26(3):201-207.

Direct selective laser trabeculoplasty in open angle glaucoma study design: a multicentre, randomised, controlled, investigator-masked trial (GLAUrious)

Nathan Congdon,[1,2] Augusto Azuara-Blanco,[1] Yoram Solberg,[3] Carlo E Traverso,[4] Michele Iester,[4] Carlo Alberto Cutolo,[4] Alessandro Bagnis,[4] Tin Aung,[5] Scott J Fudemberg,[6] Richard Lindstrom,[7,8] Thomas Samuelson,[7] Kuldev Singh,[9] Eytan Z Blumenthal,[10,11] Gus Gazzard,[12,13] and GLAUrious study group

DSLT Patient Experience





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Randomized Noninferiority Trial of Direct Selective Laser Trabeculoplasty in Open-Angle Glaucoma and Ocular Hypertension

GLAUrious Study

Gus Gazzard, MA(Cantab), FRCOphth,[1,2] Nathan Congdon, MD, MPH,[3,4,5] Augusto Azuara-Blanco, PhD,[3] Eytan Z. Blumenthal, MD,[6,7] Ketevan Gomelauri, MD,[8] Monika Zaliniyan, MD,[9] Carlo E. Traverso, MD,[10] Zohar Bracha, MD,[11] Ana Dvalishvili, MD,[12] Yoram Solberg, PhD,[13] Michael Belkin, MA(Cantab), MD,[13,14] Thomas W. Samuelson, MD,[15] on behalf of the GLAUrious Study Group

Purpose: Effective glaucoma treatment is limited by nonadherence to medications and access to selective laser trabeculoplasty (SLT). The GLAUrious study compared automated, gonioscopy-free, noncontact, image-guided direct selective laser trabeculoplasty (DSLT) with conventional SLT in open-angle glaucoma (OAG) and ocular hypertension (OHT) to reduce intraocular pressure (IOP).

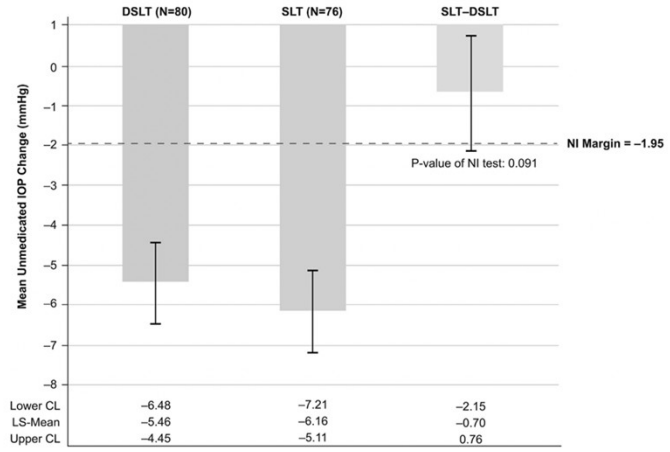


Figure 2. Graph showing the primary effectiveness outcome: 6-month mean intraocular pressure (IOP) change from baseline (6-month modified per-protocol population). CL = confidence limit; DSLT = direct selective laser trabeculoplasty; LS = least squares; NI = noninferiority; SLT = selective laser trabeculoplasty.

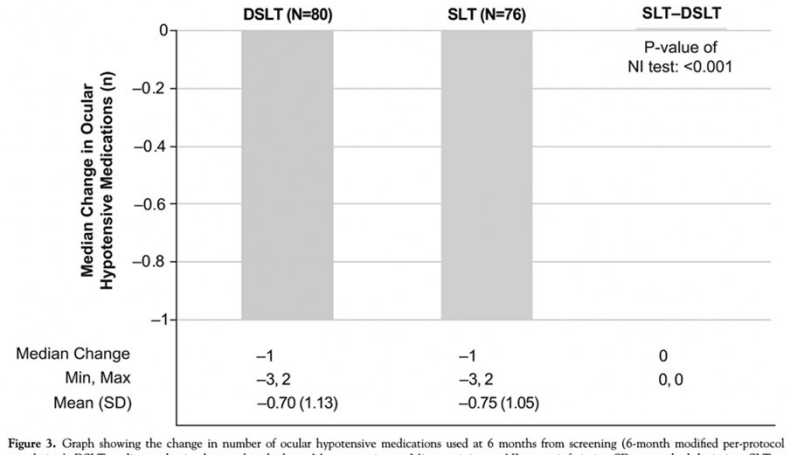


Figure 3. Graph showing the change in number of ocular hypotensive medications used at 6 months from screening (6-month modified per-protocol population). DSLT = direct selective laser trabeculoplasty; Max = maximum; Min = minimum; NI = noninferiority; SD = standard deviation; SLT = selective laser trabeculoplasty.

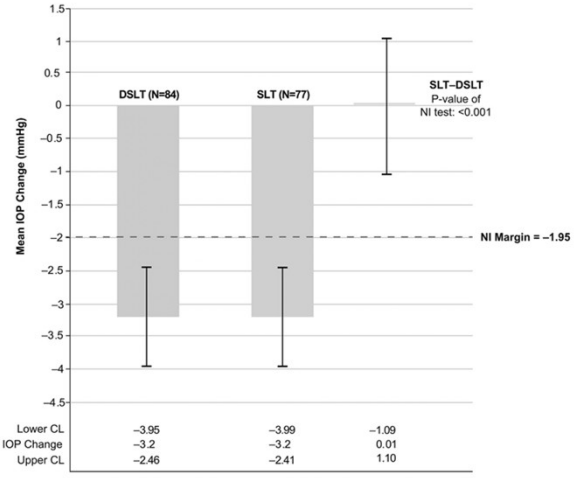


Figure 4. Graph showing the exploratory effectiveness outcome: 12-month mean intraocular pressure (IOP) change from screening (12-month modified per-protocol population). CL = confidence limit; DSLT = direct selective laser trabeculoplasty; NI = noninferiority; SLT = selective laser trabeculoplasty.

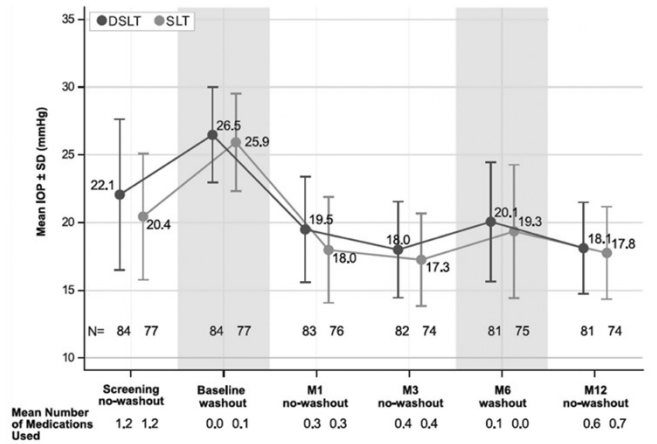


Figure 6. Graph showing the descriptive mean observed intraocular pressure (IOP) measurements over the 12-month study duration (12-month modified per-protocol population). Yellow highlighted sections indicate visits at which washout IOP was measured. DSLT = direct selective laser trabeculoplasty; M = month; SD = standard deviation; SLT = selective laser trabeculoplasty.

M

GLAUrious Trial: SLT vs. DSLT

Purpose

- Compare DSLT outcomes to manual SLT (non-inferiority)
- Demonstrate safety and efficacy of DSLT

Effectiveness Endpoints

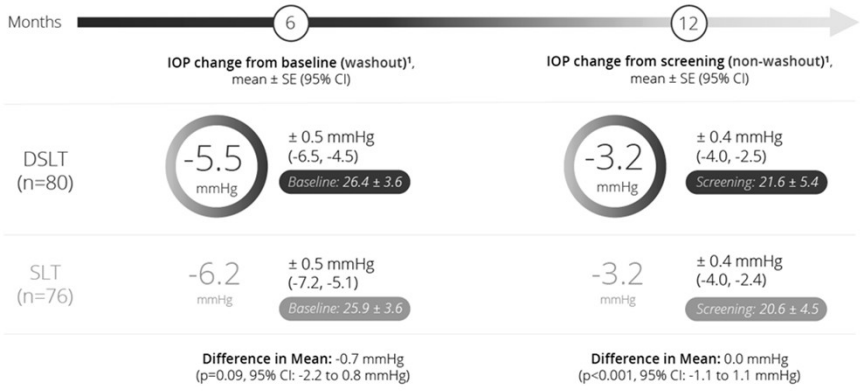
- Primary: Difference in mean IOP reduction from baseline (washout) at 6 months
- Secondary:
  1. Proportion with >20% IOP reduction at 6 months without SSI
  2. Change in # of medications at 6 months

Patient Parameters[1]	DSLT	SLT
N	80	76
Age (avg)	66.0	66.0
Male (%)	60.0%	56.6%
OAG (%)	66.3%	71.1%
OHT (%)	20.0%	10.5%
PXF + PG (%)	13.8%	18.4%
Treated Eye OD (%)	45.0%	59.2%
Screening IOP mmHg (avg ± SD)	21.6 ± 5.4	20.6 ± 4.5
Baseline Washout IOP mmHg (avg ± SD)	26.4 ± 3.6	25.9 ± 3.6
Hypotensive Med Count	1.2 ± 1.0	1.1 ± 1.0

1. GLAUrious Study - Clinical Study Report (CSR). CA-RP-01-006, Rev. 01; 2022

M

GLAUrious Trial: SLT vs. DSLT



Low-Energy SLT Repeated Annually: Rationale for the COAST Trial

Tony Realini, MD, MPH, Gus Gazzard, MD, Mark Latina, MD, Michael Kass, MD

Newly diagnosed POAG treated with:
1. ALT 360 x 1
2. Standard SLT 360 as needed
3. Low-energy SLT 360 repeated annually

10-year Results
Medication Free Rates
1. ALT – 22.6%
2. Standard SLT -25.0%
3. Low-energy SLT – 58.3%

10-year Results
Median Times to Treatment
1. ALT – 2.8 years
2. Standard SLT -3.2 years
3. Low-energy SLT – 6.2 years

Published in final edited form as:
J Glaucoma. 2021 July 01; 30(7): 545–551. doi:10.1097/IJG.0000000000001788.

Low-Energy Selective Laser Trabeculoplasty Repeated Annually: Rationale for the COAST Trial

Tony Realini, MD, MPH[1], **Gus Gazzard, MD**[2], **Mark Latina, MD**[3], **Michael Kass, MD**[4]

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[2]NIHR Biomedical Research Centre at Moorfields Eye Hospital NHS Foundation Trust, London, UK; University College London, UK

[3]Department of Ophthalmology, Tufts University, Boston, MA

[4]Department of Ophthalmology and Visual Sciences, Washington University, St. Louis, MO

Abstract

At the 2018 annual meeting of the Association for Research in Vision and Ophthalmology (ARVO), Stephano Gandolfi presented a retrospective study of his patients at the University of Parma, Italy, in which a regimen of low-energy selective laser trabeculoplasty (SLT) repeated annually irrespective of intraocular pressure (IOP) produced significantly longer medication-free survival than standard SLT repeated as needed, in patients with primary open-angle glaucoma

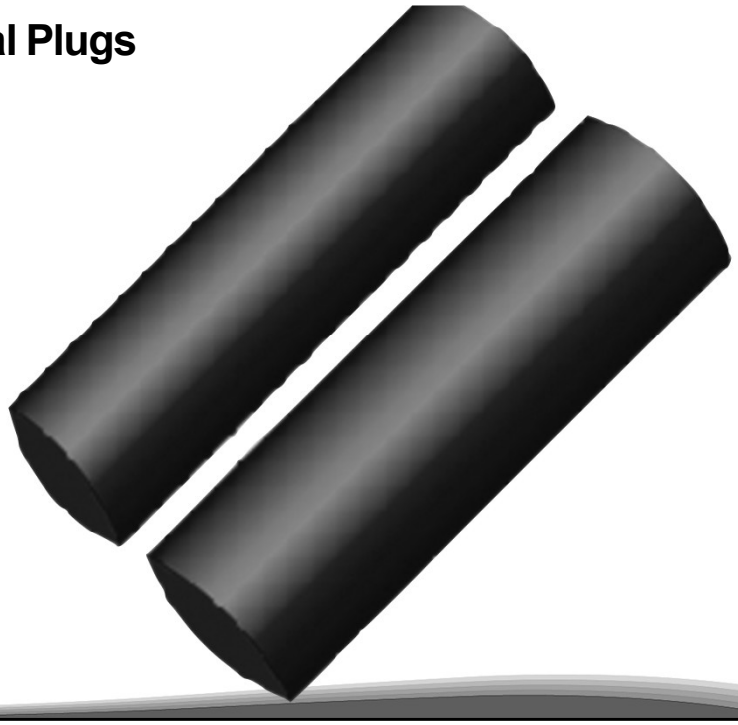
Abstract

At the 2018 annual meeting of the Association for Research in Vision and Ophthalmology (ARVO), Stephano Gandolfi presented a retrospective study of his patients at the University of Parma, Italy, in which a regimen of low-energy selective laser trabeculoplasty (SLT) repeated annually irrespective of intraocular pressure (IOP) produced significantly longer medication-free survival than standard SLT repeated as needed, in patients with primary open-angle glaucoma (POAG) or high-risk ocular hypertension (OHTN).[1] Specifically, newly-diagnosed POAG eyes were treated primarily either with ALT 360° performed once, standard SLT 360° repeated as needed at standard energy, and low-energy 360° SLT (0.4 mJ/spot x 50–60 spots) repeated annually at low energy regardless of IOP. After 10 years of follow-up, medication-free rates were 22.6% in the ALT group, 25.0% in the standard SLT group, and 58.3% in the low-energy SLT group ($p<0.001$). The median times to medication were 2.8 years, 3.2 years, and 6.2 years, respectively. In light of the recent Laser in Glaucoma and Ocular Hypertension Trial (LiGHT)

~15 years after the diagnosis of POAG.[110] If we validate an SLT treatment strategy that extends the duration of medication-free disease control, we move one step closer to the possibility of a drop-free lifetime for our patients. Delaying the need for medications by 3, or 5, or 7 years not only confers all the benefits of medication-freedom during this period (which will be all that many patients would need in their lifetimes)—it also allows time for development of safer and more effective drugs dosed infrequently via sustained-release delivery systems, as well as better surgical options, for patients whose lifespans exceed SLT responsiveness. Thus, a new treatment paradigm consisting of SLT, then sustained-release medications, followed by minimally invasive glaucoma surgery and then—for the few who will progress this far—filtering procedures could offer the majority of glaucoma patients the very real possibility of a drop-free lifetime of therapy. As instruments to measure glaucoma *treatment-related* qualify of life are developed and validated, the benefits of freedom from the responsibility and detractions of daily medication self-dosing on our patients' well-being are likely to become apparent as well.

Innovations in OSD Instrumentation and Advanced Procedures

Innovations in Punctal Plugs

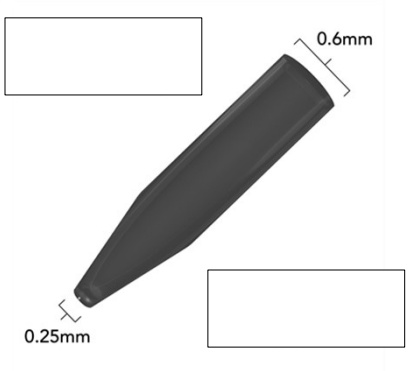


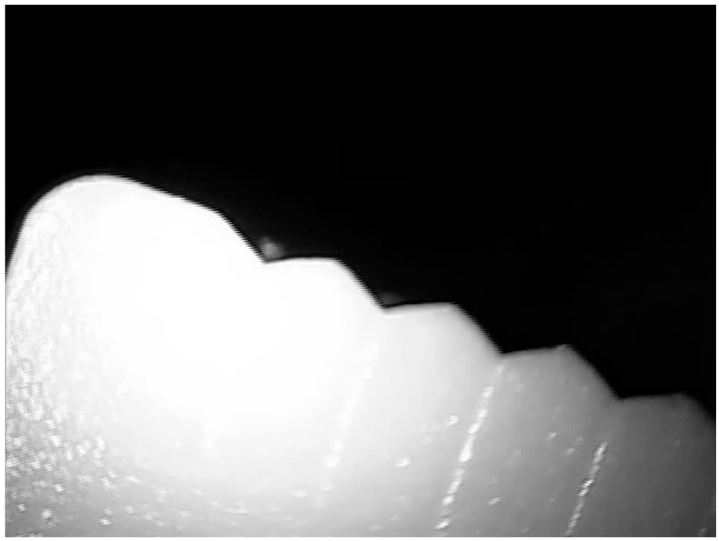
Extended Duration Punctal Plug Insertion

- Variable sizes
- Last ~180 days

Tapered Extended Duration Plugs

Vertical Canal

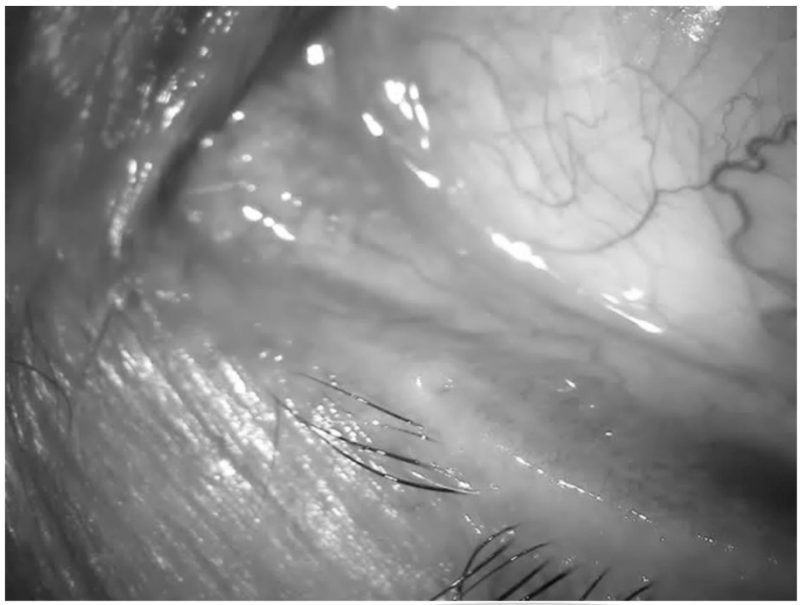




Form Fitting Punctal Plugs

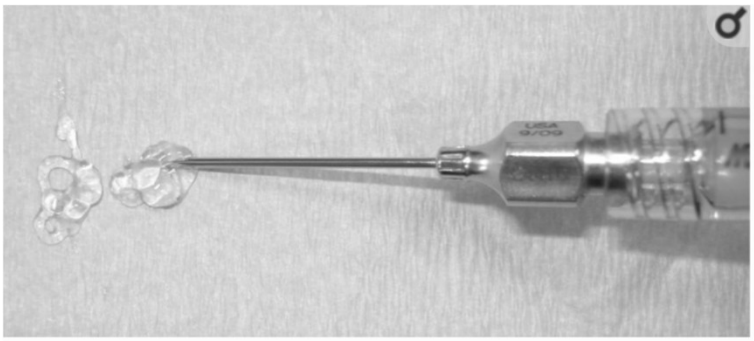
Vertical Canal is Key

- Fits any size punctae
- Can be flushed with BSS

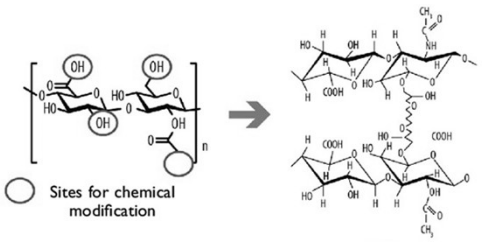


Canalicular Gel

- Cross-linked hyaluronic acid gel that allows patient's eyes to be bathed in their own natural tears
- Customized for each individual patient or provide full fill of the canalicular system



Intricate Crossing of Hyaluronic Acid Chains to Create Gels



Hyaluronic Acid before Cross Linking

Cross Linking with BDDE

Reusable Cannula (supplied separately)

Easy delivery of gel into canaliculus. "Dilate, Dock, Deliver" functions

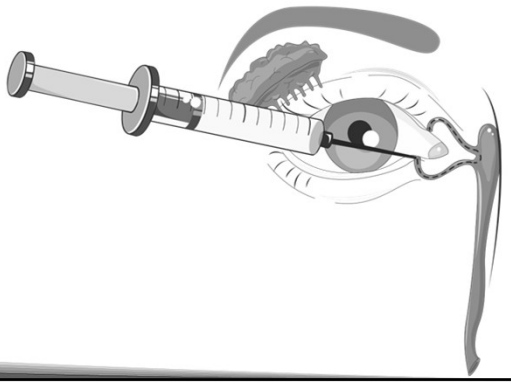
Kit Box

Sterile Gel
(In Pre-Filled Syringe)

Syringe Package

Instructions for Use

1. Pre-filled injector with enough gel to treat the lower and upper canaliculi.
2. A cannula tip is placed in the punctum and the gel is inserted.
3. The gel flows through the punctum into the lacrimal sac.
4. If you see the gel extruding from the upper punctum, you know that both the upper and lower puncta have been blocked.

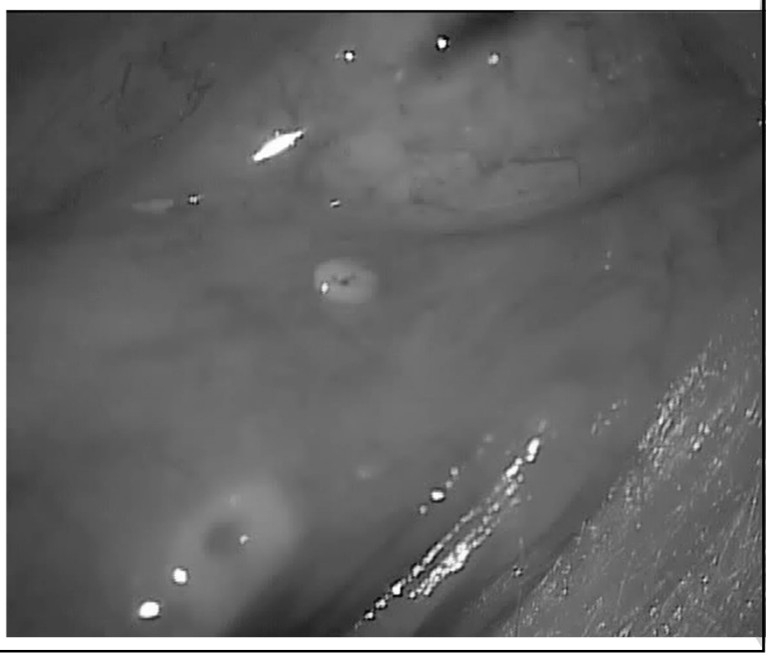


Concretion Removal lower eyelid

Topical anesthetic into eye

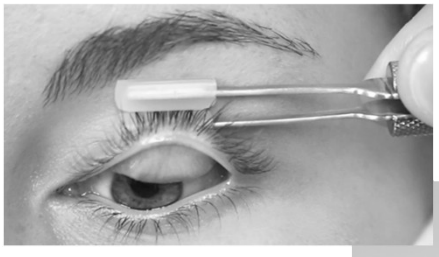
- Use 30 gauge needle, bevel out
- Remove conjunctival epithelium
- Expose and then remove with forceps

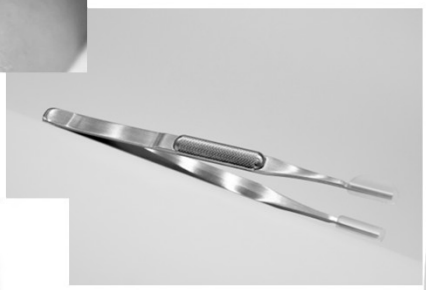
- Apply pressure with Q-tip if any bleeding
- Consider soaking Q-tip in phenylephrine



Eyelid Evertors

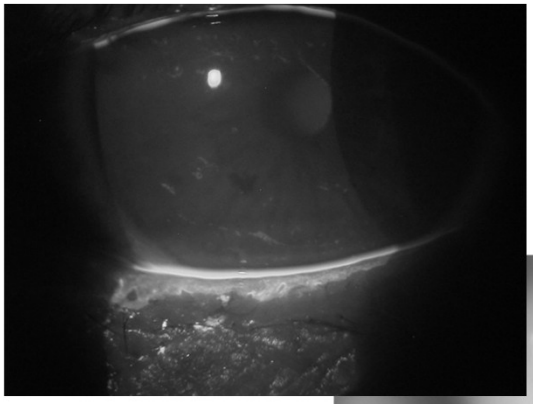
- Silicone soft but grips well
- Painless
- Maintains hold
- Like a 3rd hand

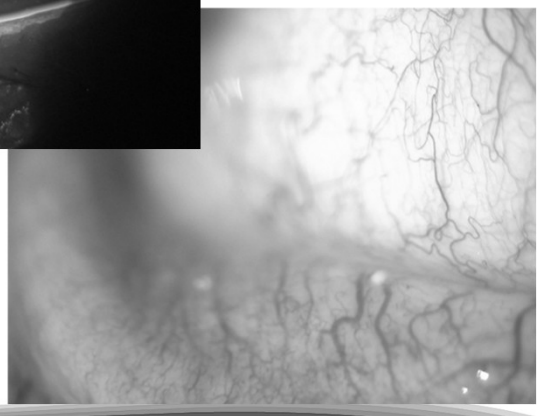




Eyelid Evertors

- Foreign Body Removal
- Concretion removal



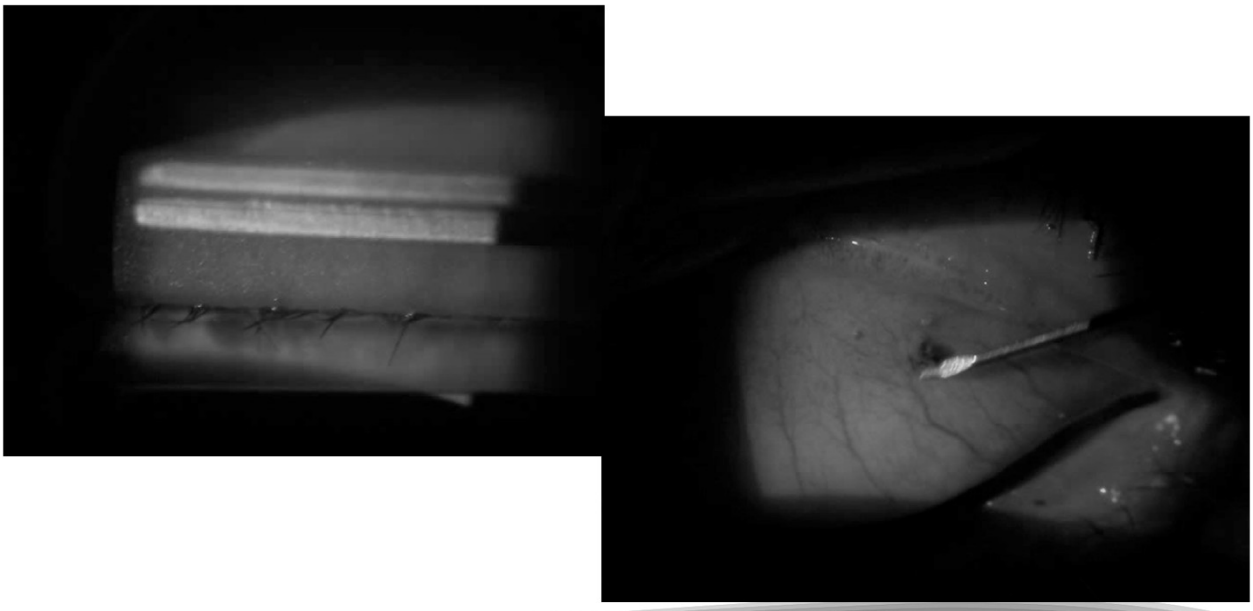


Concretion Removal upper eyelid

Great benefit from the Meivertor

- Attach the silicone pads
- Grasp lashes
- Flip eyelid and hold

Eyelid Everter Concretion Removal



Pipeline Angle Based Laser Technologies

- OCT Guided Femtosecond Laser Trabeculostomy
- Excimer Laser Trabecular MIGS
- Low Energy Annual SLT

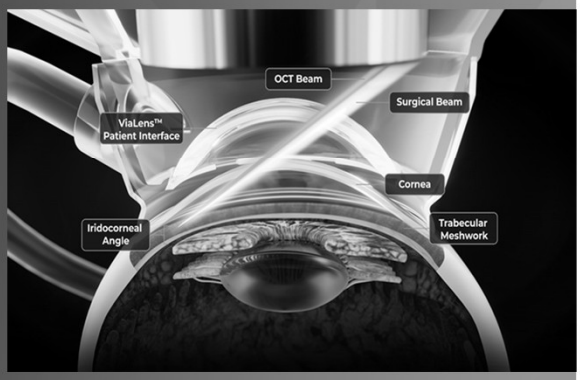
OCT Guided Femtosecond Laser Trabeculostomy

- Decreases IOP by increasing aqueous outflow
- Non invasive/Clear Corneal incision of probe with the aid of a goniolens for angle visualization
- OCT guides the femtosecond into the angle where customized channels are created through the trabecular meshwork
- Elios vision

A Surgical Procedure Without the Surgery

The first Femtosecond Laser Image Guided High-precision Trabeculotomy (FLIGHT)

- **Ultra HD gonioscopic & OCT imaging** identify landmarks with micron accuracy
- **Incision-free** femtosecond laser creates **precise apertures** in the trabecular meshwork to lower IOP
- **Repeat treatments can be performed** as needed to maintain results



Femtosecond Laser Image Guided High-precision Trabeculotomy (FLIGHT) Procedure

Elios Laser Trabeculostomy

- ELIOS uses high precision, non-thermal, laser ablation to create 10 microchannels in the trabecular meshwork to enhance physiological outflow into Schlemm's canal while preserving angle anatomy.

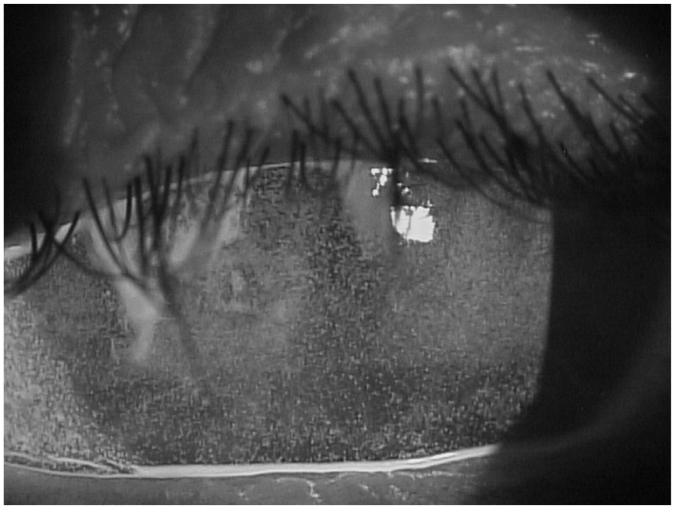
Elios Laser Trabeculostomy

Micropulse Laser Trabeculoplasty

- Delivers energy in repetitive microsecond pulses followed by intermittent rest periods
  - Reduces buildup of thermal energy and reducing coagulative damage to the TM

Amniotic Membrane Placement

- Persistent corneal staining from OSD ranging from NK to KCS, LSCD, SLK etc.



Amniotic Membrane

- Natural, sureless treatment option fo the eye that uses the inner most layer of the placenta to promote healing
- Anti-inflammatory, anti-scarring,a nd anti-fibrotic properties
- Often used to treat recurrent corneal erosions, significant/severe dry eye, neurotrophic ulcers, chemical or physical burns to the eye

Amniotic Membrane- Dehydrated

- Preserved by using vacuum with low temperature heat to retain devitalized cellular componenets
- FDA approved claims for dehydrated membranes are limited to wound coverage
- Stored at room temperature
- Placed on the ocular surface with an overlying bandage contact lens

Dry Amniotic Membrane Insertion

- **Typically used for SLK or Exposure Keratitis**

- Dehydrated amnion forceps
- Dry forceps prevent curling or rolling up of amnion

Amniotic Membrane Types

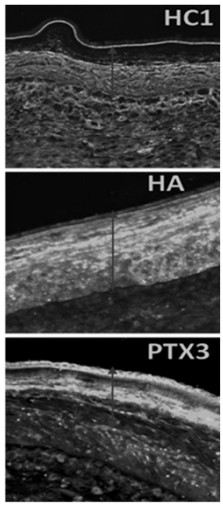
- **Cryopreserved**

Pros
- FDA Approved
- Proprietary Freezing Process
- Ease of use (fitting a contact lens)

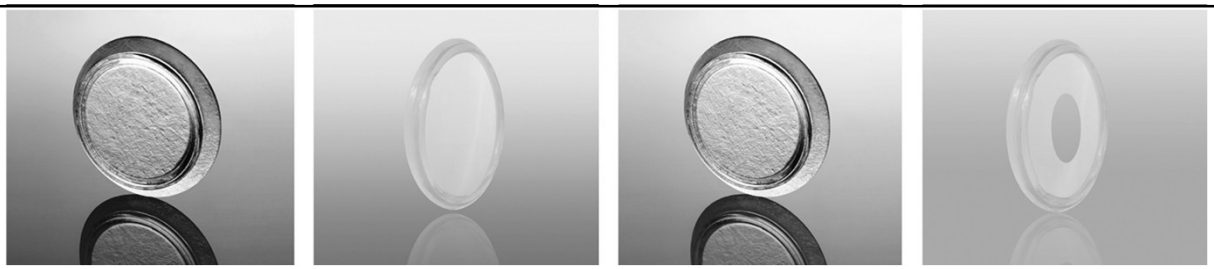
Cons
- Requires refrigeration and space in office
- Has to be thawed before use
- Ring placement can be uncomfortable
- Shorter shelf-life
- Price

The Key Complex Responsible for Unique Therapeutic Effects in Fresh AM and CAM

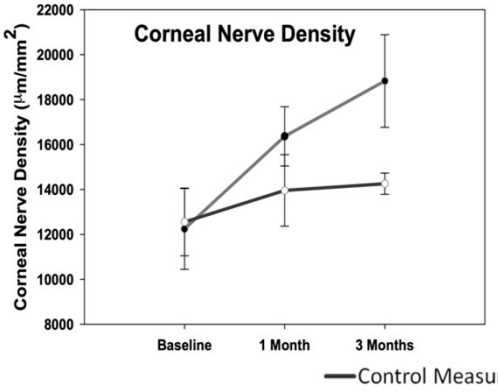
Heavy Chain-Hyaluronic Acid / Pentraxin 3 (HC-HA/PTX3)

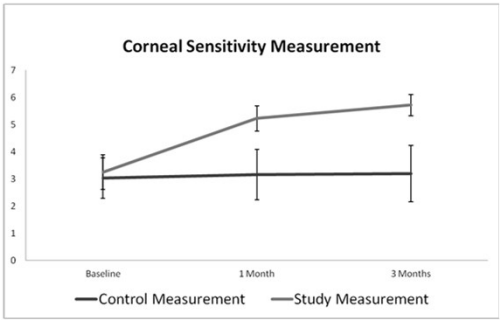


He et al, J. Biol. Chem., 284:20136-46, 2009; Zhang et al, J. Biol. Chem., 287:12433-44, 2012; He et al, J. Biol. Chem. 288:25792-803, 2013; Zhang et al, J. Biol. Chem, 289:13531-42, 2014; Tseng, IOVS, 15-17637, 2015



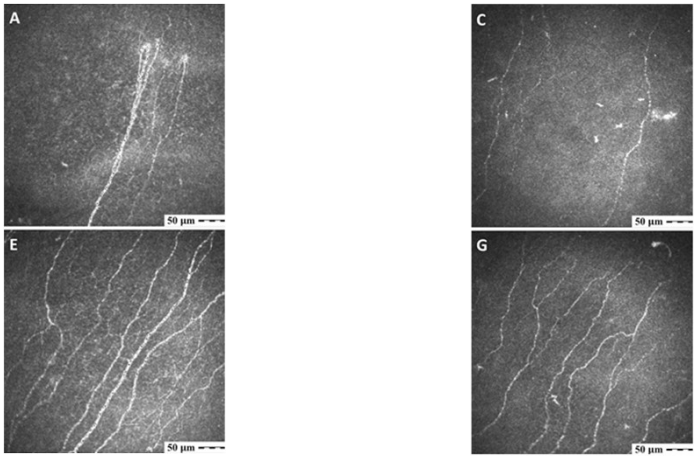
Improvements in Corneal Nerve Density & Sensitivity





John T, Tighe S, Sheha H. et al (2017). "Corneal Nerve Regeneration After Self-Retained Amniotic Membrane in Dry Eye Disease. Journal of Ophthalmology."

In Vivo Confocal Microscopy Images of Patients Before and After PKS/PKC Placement (Morkin & Hamrah)



E = 36 days after PKS/PKC

*** Improved corneal neuralgia**

1. **Morkin, M. I. and P. Hamrah** (2018). "Efficacy of self-retained cryopreserved amniotic membrane for treatment of neuropathic corneal pain." Ocul Surf 16(1): 132-138.

Amniotic Membrane Types

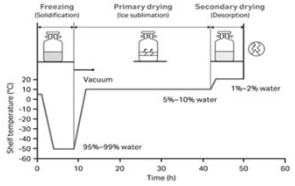
- **Dehydrated**
  - Pros
    - Patient comfort
    - Variety of sizes
    - Reduced cost
    - Ease of use
  - Requires BCL for retention or Lid Seal
  - BCL can cause hypoxia
  - Amniotic Membrane
    - Sizes: 8mm, 10mm, 12mm &14mm
    - Stored at room temperature
    - Shelf life of 5 years
    - Product can be placed either side down on ocular surface

Neurotrophin-3/Neurotrophin-4	NT-3/NT-4
Basic fiberblast growth factor	bFGF
Beta nerve growth factor	β-NGF
Epidural growth factor/Epidermal growth factor receptor	EGF/EGF-R
Glial cell line-derived neurotrophic factor	GDNF
Heparin binding growth factor	HB-EGF
Hepatocyte growth factor	HGF
Platelet-derived growth factor	PDGF-AA/PDGF-BB
Placenta growth factor	PlGF
Stem cell factor	SCF/SCF-R
Transforming Growth Factor Alpha	TGFa/TGFb1/TGFb3
Vascular endothelial growth factor	VEGF

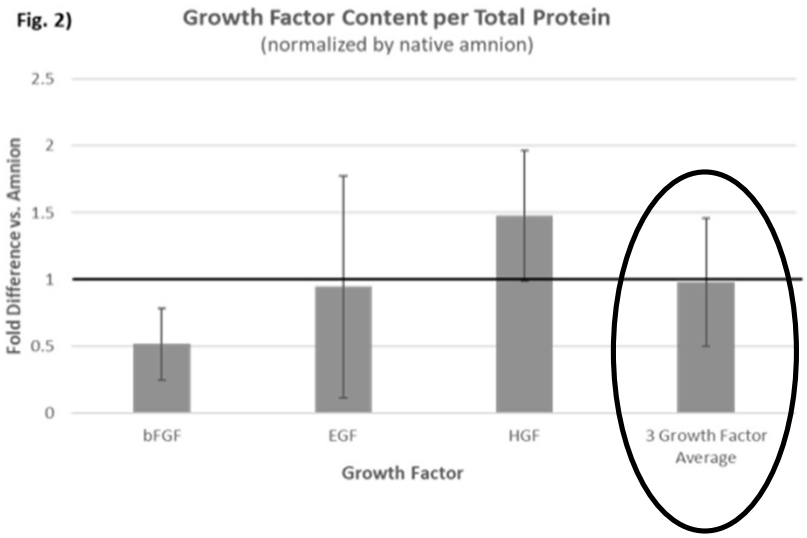
Protein	Abbreviation
Growth differentiation factor 15	GDF-15
Interleukin 1α	IL-1α
Interleukin 1 Beta	IL-1β
Interleukin 1 receptor antagonist	IL-1ra
Interleukin 12 p40	IL-12p40
Interleukin 17	IL-17
Osteoprotegerin	OPG
Interleukin 8	IL-8
Intercellular adhesion molecule 1	ICAM-1
Tumor necrosis factor	TNF
Interleukin 4	IL-4
Interleukin 5 receptor	IL-6R
Macrophage colony-stimulating factor 1 receptor	MCSF R
B lymphocyte chemoattractant (CXCL 13)	BLC
Eotaxin 2	Eotaxin-2

Amniotic Membrane Types

- **Lyophilized**
  - A preservation process in which water is removed from tissue products after freezing
  - Completed in a vacuum chamber, which allows the ice to change directly from a solid to a gas without passing through the liquid phase
  - The lyophilization process avoids exposure to the matrix- and protein-damaging effects of high heat



Lyophilized Amniotic Membrane Types



Amniotic Membrane- Cryopreserved

- Preservation at –80 C allows for slow-rate freezing without ice formation
- This technique retains the extracellular matrix componenets that modulate inflammation to orchestrate a regenerative healing environment
- Stored cold until ready for use

Amniotic Membrane Insertion: CryoPreserved

Amniotic Membrane Insertion: Dehydrated

- Dehydrated forceps
- Prevents stabbing the conjunctival or cornea
- Dry forceps prevent curling or rolling up of amnion

Lyophilized Amniotic Membrane Insertion

- Topical anesthetic
- Topical antibiotic if applicable

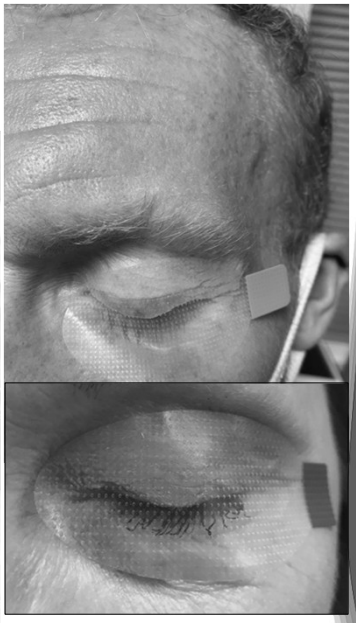
- **Apply membrane directly to area of pathology**

- Hydrated weck cell or Q-tip after placement
- Place BCL over amnion

Amniotic Membrane Forceps for Removal and Eyelid Closure

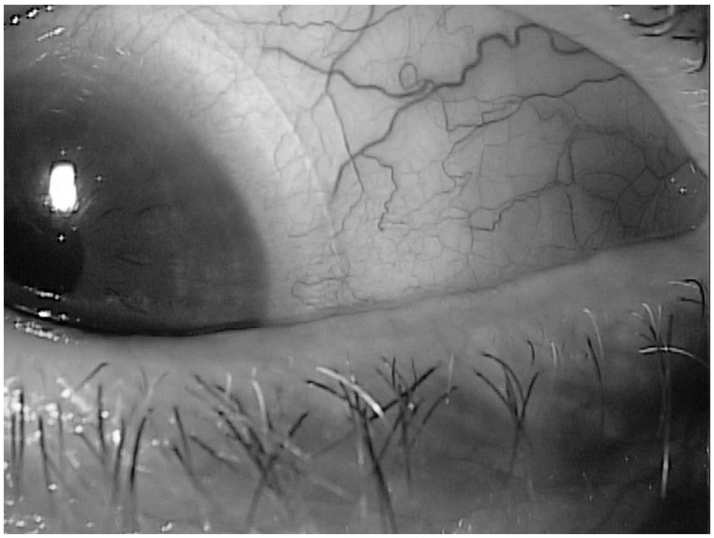
- Cryopreserved forceps
- Prevents stabbing the conjunctival or cornea

Hypoallergenic lid seals, oxygen permeable, latex free, non-irritating



Bandage Lens Forceps

- Smooth edge
- Breaks suction
- Prevents epithelial sloughing or defects



Laser Peripheral Iridotomy Indications:

- Primary Angle Closure
  - Acute or intermittent
- Prophylaxis
  - Narrow angle or Previous attack in other eye
- Pigmentary Glaucoma?

Plateau Iris

LPI Contraindications

- Corneal non-transparency
- Iris in contact with endothelium
- Angle Closure Secondary to Neovascular or inflammatory glaucomas
- Traumatic injury causing closure; any hyphema

PI Precautions

- ASA
- Lid Position
- Shallow Anterior Chamber
- Corneal status
- Uveitis and CME history
- Glaucoma status
- Monocularity/Nystagmus

PI Laser Selection

- Nd:YAG
  - Penetration rate 95%
  - Photodisruption (non-pigment dependant)
  - Initial energy 1.5 to 2.0 mJ
    - Least energy with successful perforation, max of ~6mJ
  - Focus carefully (remember laser offset)
  - Increased risk of bleeding
  - More likely to be hindered by debris

PI Procedure

- Confirm diagnosis, comprehensive exam
- Informed consent
- Pretreat with 1% Apraclonidine and 2-4% Pilocarpine one hour before procedure
- Pre-op vitals
- Abraham iridotomy laser lens
- Select PI location
  - Lid location, crypt, multiple PI

PI Follow-up

- Continue routine glaucoma meds (caution with PGA and Pilo)
- Pred-Forte qid for 1 week
- Exams at 1 day, 1 week, 1 month

PI Complications

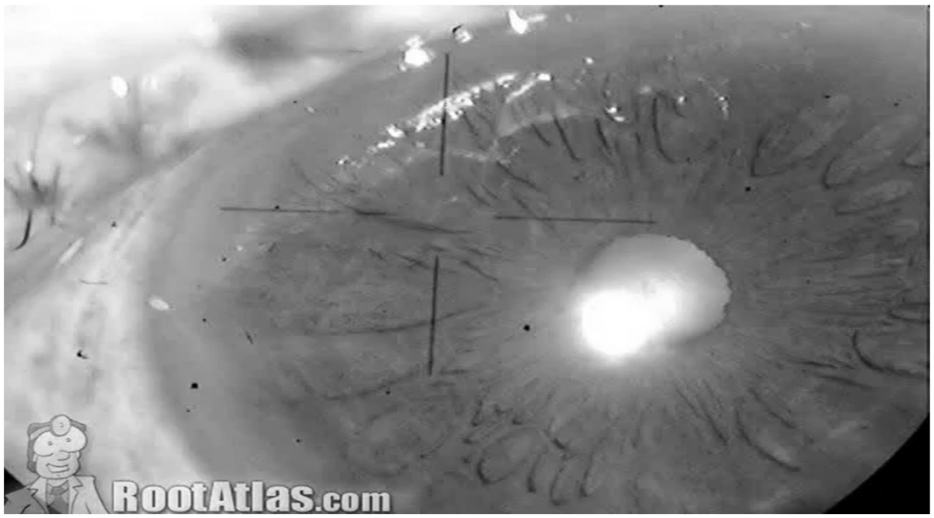
- Transient blur
- Uveitis
- IOP Spike
- Hyphema
- Synechia formation
- Others: Monocular diplopia, Peaked pupil, Corneal/lesn/retina damage, RD, CME

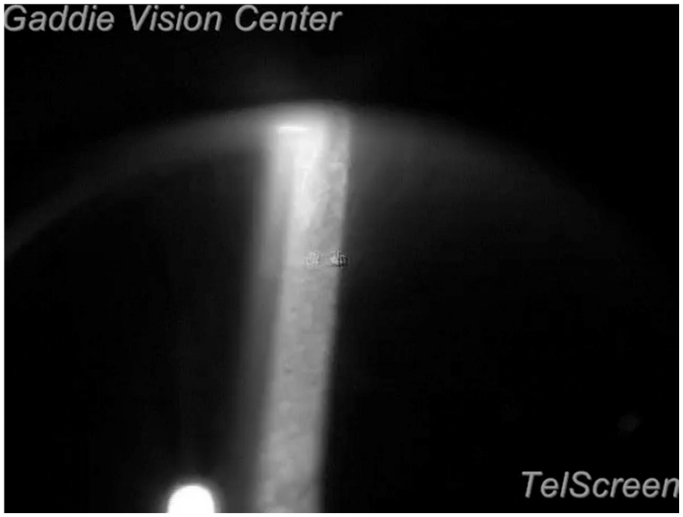
PI Pearls

- Penetrate iris is first order of business
- Careful selection of treatment location
- Use Contact Lens
- Tilt lens to clear reflections and achieve tight focus of laser aiming beam
- Titrate total energy depending on history (uveitis, corneal health, glaucoma, CME)
- Avoid treating loose strands

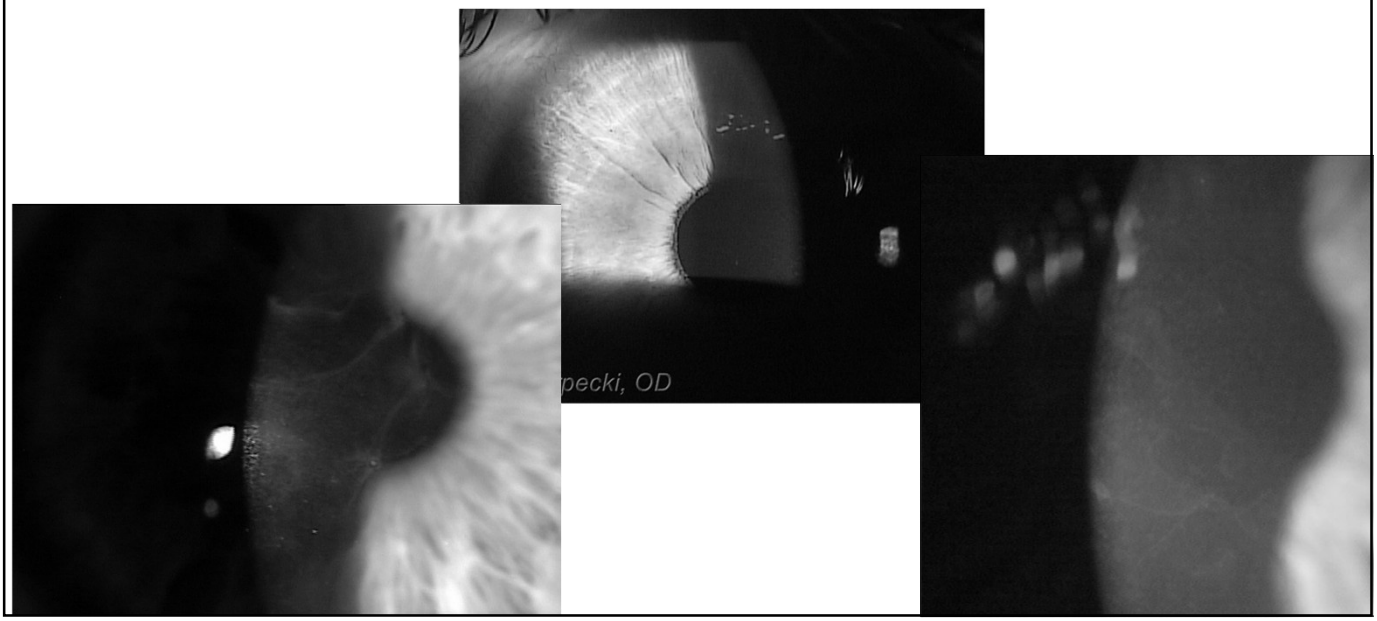
PI Success

- Patent PI at 6 weeks
- Deepening of anterior chamber
- IOP control
- No persistent complications
- Bridging of PI post op?


RootAtlas.com


Gaddie Vision Center
TelScreen

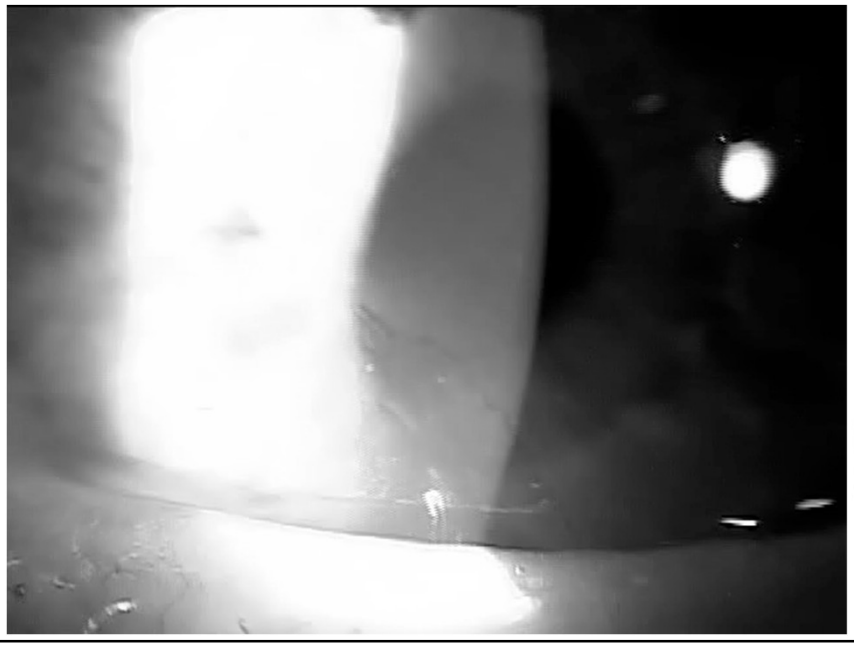
EBMD/ABMD/Map Dot Fingerprint Dystrophy



RCE Epithelial Debridement/Superficial Keratectomy for EBMD

Topical anesthetic and flood the eye with antibiotic drops (e.g. ocufloxacin)

Betadine wipes for adnexa, lashes etc.

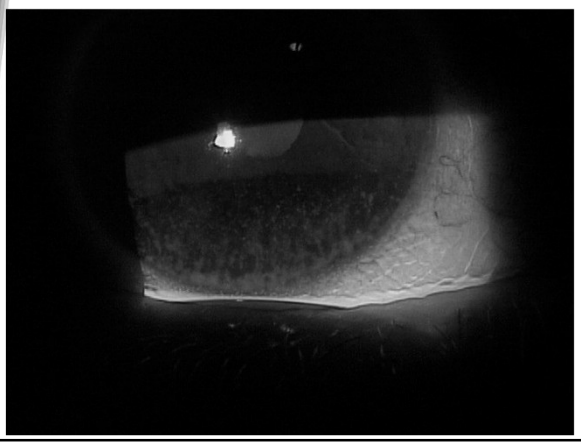


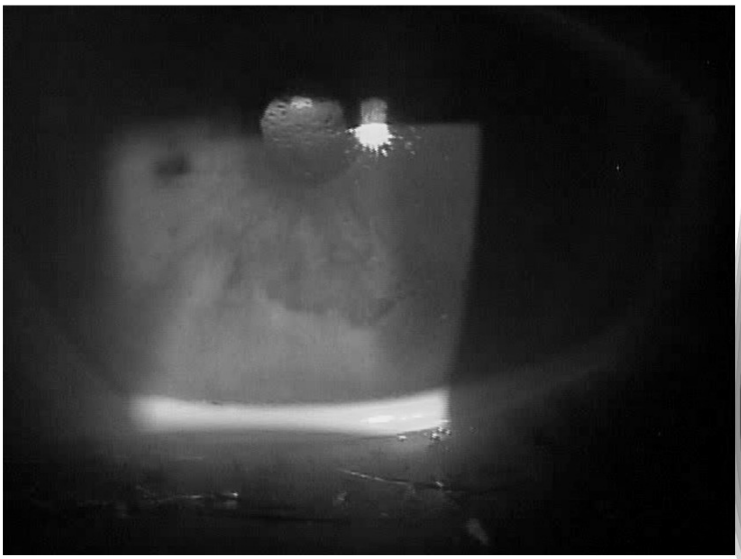
RCE Epithelial Debridement/Superficial Keratectomy for EBMD

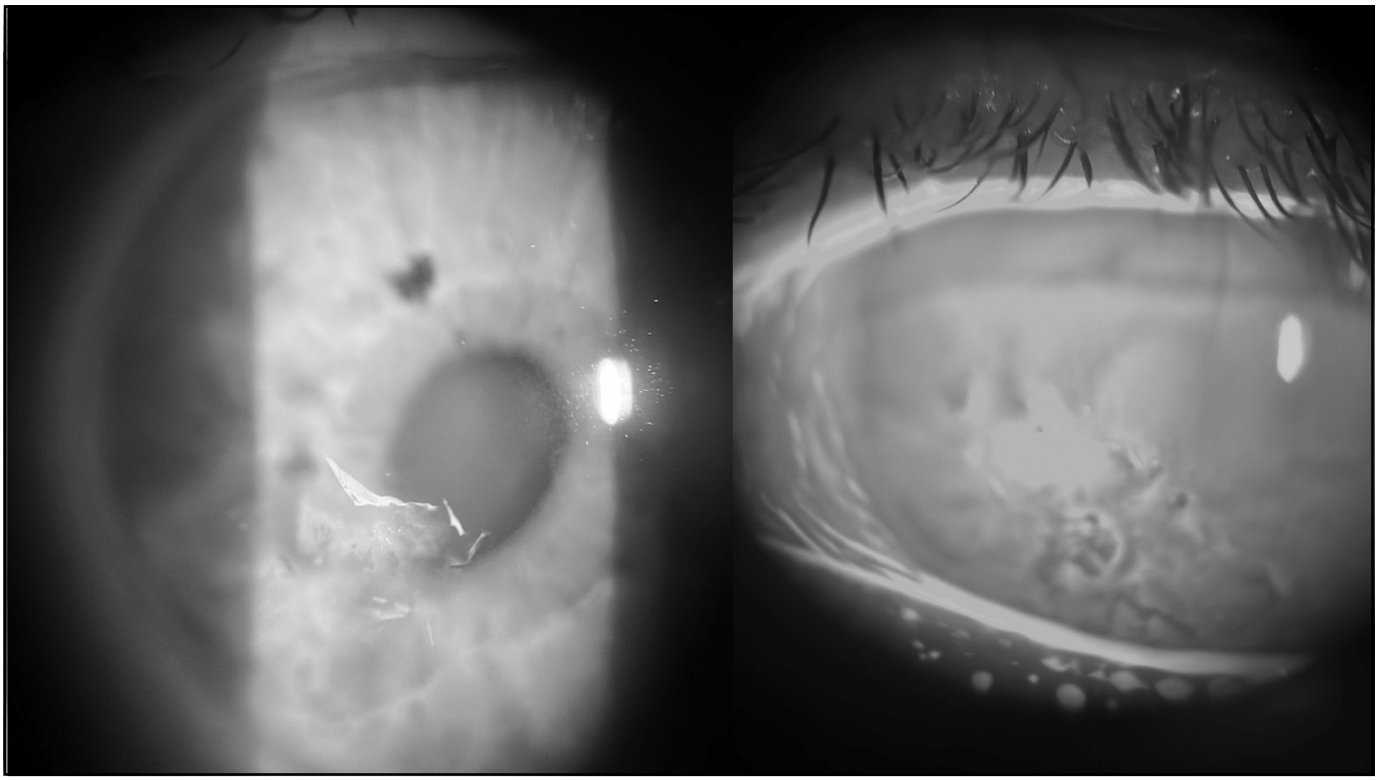
Identifying the area of EBMD/RCE - higher magnification prior to NaFl dye

RCE Epithelial Debridement/Superficial Keratectomy for EBMD

Identifying the area of EBMD/RCE can be subtle and NaFl dye can help

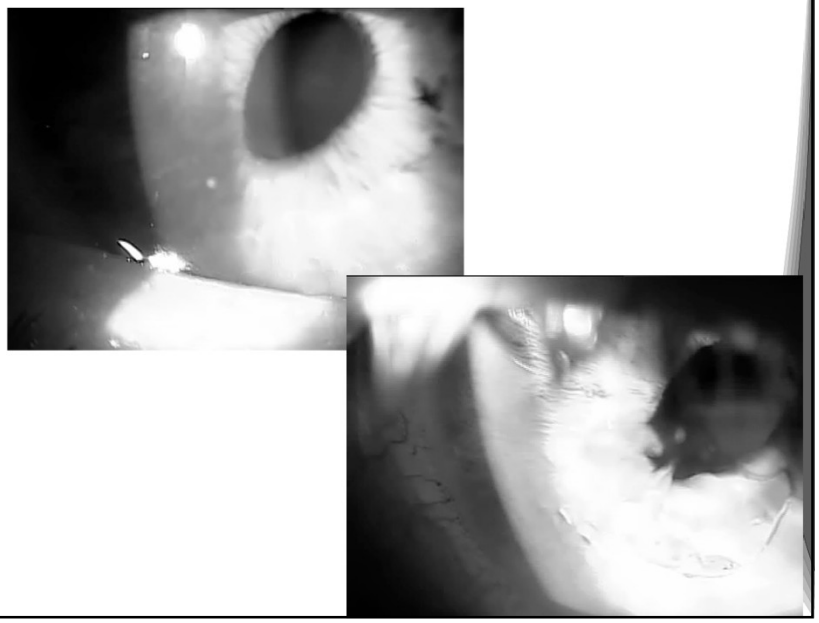






RCE Epithelial Debridement/Superficial Keratectomy for EBMD

- Begin with Weck Cell Sponge, tough areas of RCE/EBMD
- Move toward limbus but maintain 1-2 mm from the limbus in debridement
- Finish with a derider for edges that are not smooth
- Add antibiotic during and end of procedures
- Cover with amniotic membrane
- Remove in 3-4 days
- Begin topical steroids and hyperosmotics



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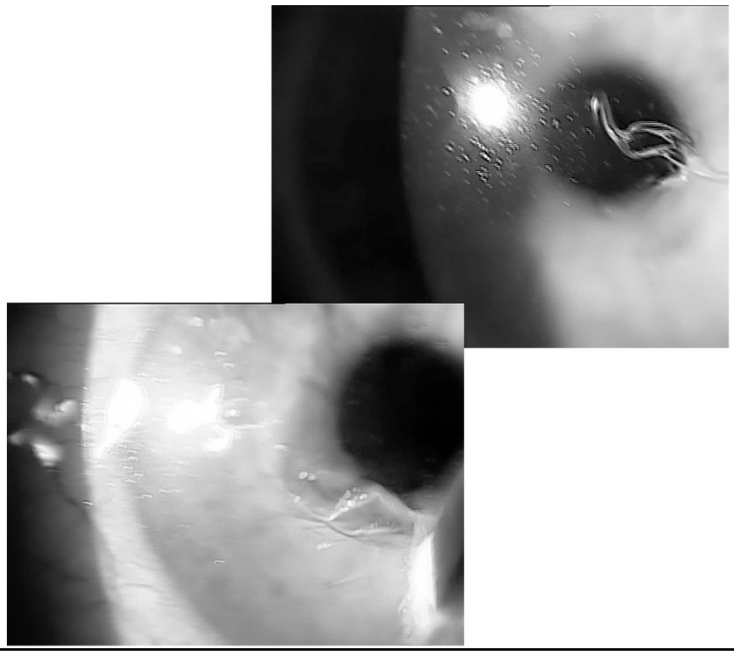


SK CPT Coding Options Today

65436 (CPT code 65436 is a Current Procedural Terminology (CPT) code used to describe a medical procedure that involves the surgical scraping or cleaning of the cornea.

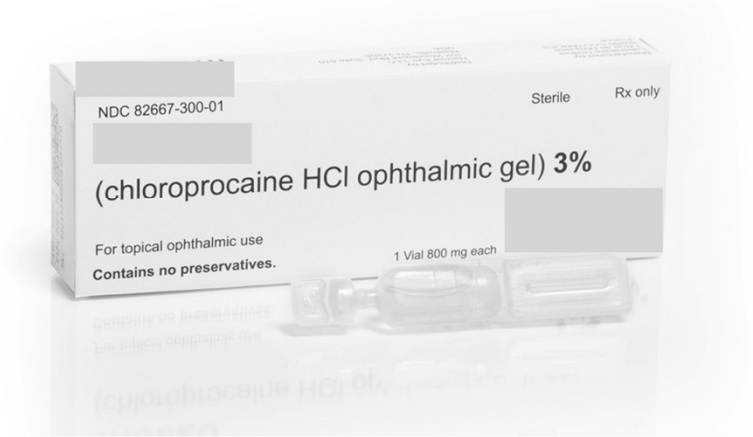
This procedure is often used to treat corneal conditions by removing damaged or diseased tissue and promoting healing.

The code may also include the application of a chelating agent, such as EDTA

Amniotic membrane placement: 65778

Placement of an amniotic membrane on the ocular surface without sutures. This code is used for both dry and cryopreserved amniotic membranes.

Chloroprocaine HCl ophthalmic gel 3%



- Indicated for ocular surface anesthesia[1]
- Contraindicated in patients with a history of hypersensitivity to any component of this preparation[1]
- Most common adverse reactions following administration were mydriasis (26%), conjunctival hyperemia (11%), and eye irritation (6%).[1]

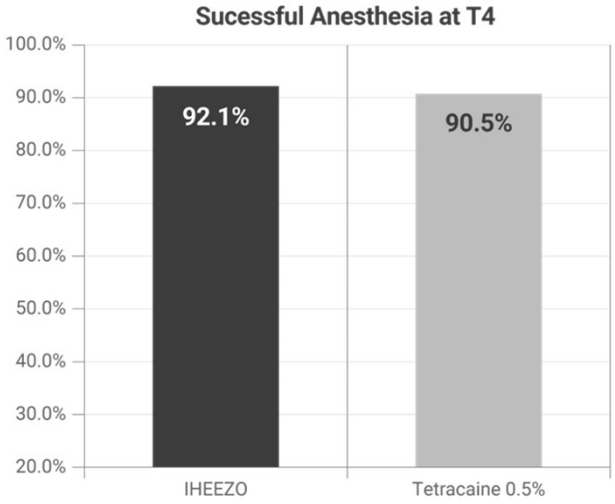
Dosage and Administration[2]

- 3 drops applied topically to the ocular surface in the area of the planned procedure
- May be reapplied as necessary to maintain anesthetic effect

Dosage Form and Strength[2]

- Chloroprocaine hydrochloride gel 3%
- 24 mg of chloroprocaine hydrochloride per unit (800 mg of gel)

Phase III Trial – Primary End Point Met



- Results of trial showed successful anesthesia with 92.1% of patients in and 90.5% of patients in the tetracaine arm
- Patient discomfort was measured on a scale of 0 to 5, with 0 being no pain or discomfort and 5 being severe or intolerable
- Successful surface anesthesia was defined as a patient rating of 0 or 1 just before intraocular lens insertion without any supplemental treatment

- A single dose—3-drops[1]
- Established safety profile[2]
- Low-viscosity gel[3,4]
- Preservative-free[1]
- Non-opioid[2]
- Single-use ampule[1]

The first FDA-approved topical ocular anesthetic to receive pass-through status†

Has a permanent, unique J-code (J-2403) to help facilitate reimbursement

RCE Epithelial Debridement/Superficial Keratectomy for EBMD

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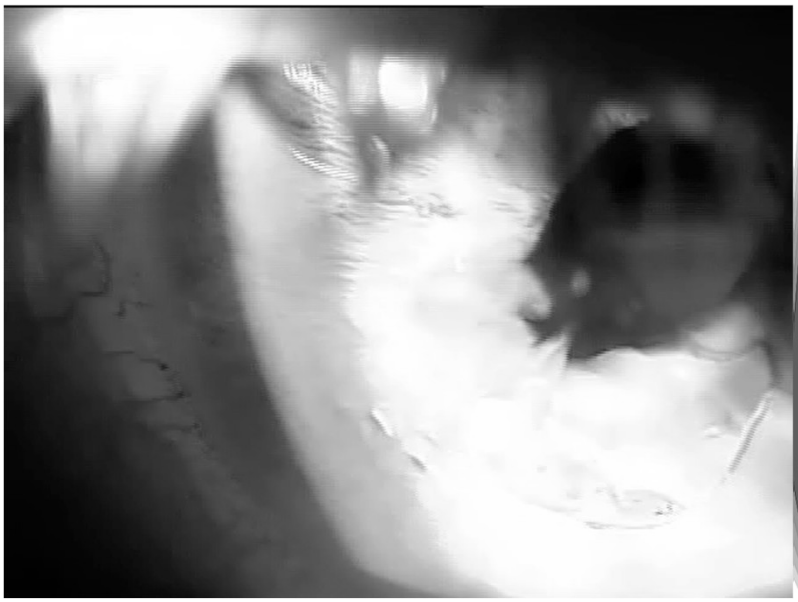

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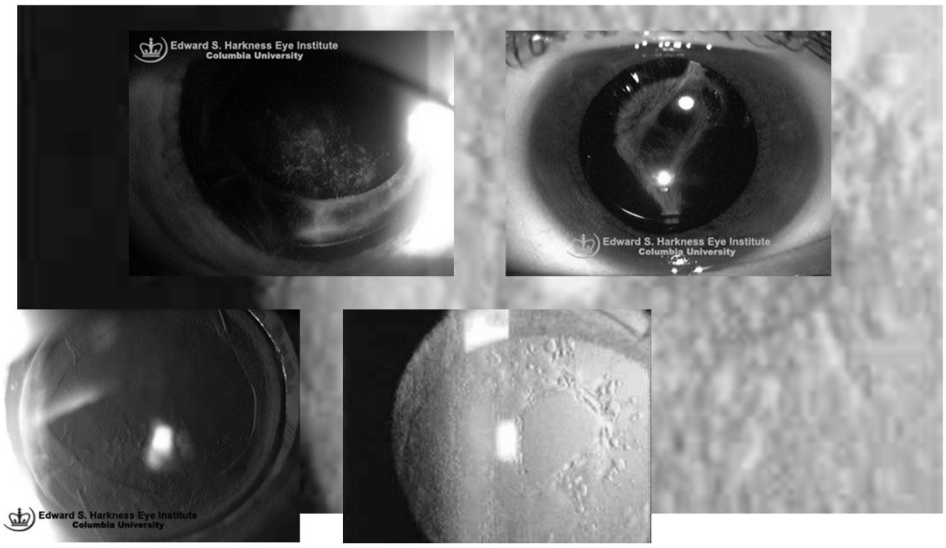
Posterior Capsular Opacification

- The lens capsular bag has an anterior and posterior surface.
- A hole is made in the anterior surface through which the natural lens is removed and IOL is inserted.
- A PCO is the formation of a membrane on the posterior surface of the capsurlar bag following extracapsular cataract extraction.
- Also known as is a secondary cataract

Posterior Capsular Opacification



Posterior Capsular Opacification

Etiology:

- Natural lens cells remain in the capsule post lens extraction
- Anterior and Peripheral natural lens epithelium migrate onto the posterior capsule and continue to proliferate and accumulate forming Elschnig's Pearls
- Metaplasia of lens epithelium cells into myofibroblasts which cause fibrosis upon capsular contracture.
- Elaboration of a basement membrane and collagen synthesis leading to whitish fibrotic opacification

Patient Symptoms

- Blurred Vision
- A haze or cloud over the vision
- Loss of acuity
- Decreased contrast sensitivity
- Glare at night
- Halos at night
- Double Vision
- Asthenopia

Preparation

- Comprehensive Exam
- Dilation (note pupil location first!)
  - 2.5% Phenylephrine
  - 1% tropicamide
- History and Physical Info
  - Allergies
  - Medications
  - Respiration
  - Pulse
  - Blood Pressure
  - Temp
- Consent form – explain complications
- Contact lens – to use or not??
- Topical anesthetic
- Topical 1% Iopidine – 1 hour prior to treatment

Yag Capsulotomy Considerations

- When you have seen one cap. , you have seen one cap
- Turn it up; Start 2.0 mj. (Older laser not as hot
  Adjust power as you move around capsule if needed)
- One shot. One progression
- Methods. Cross. Clear the capsule once and for all

Contact Lens

- Advantages
  - Stabilizes eye
  - Lid control
  - Increases cone angle
  - Magnifies target
  - Stablizes purkinje images
  - Does not alter the λ of light

- Disadvantages
  - Complicates the procedure
  - Slows the procedure
  - Reflections
  - Bubbles

Patient Education

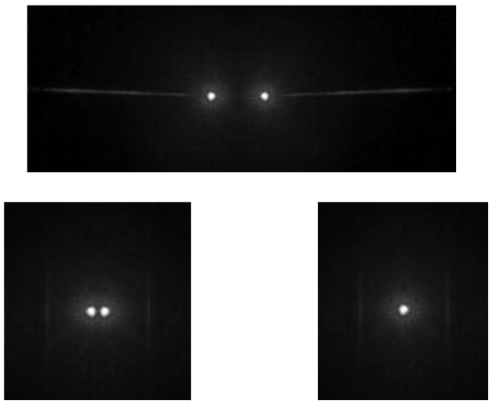
- Auditory and Visual Expectations
  - White and red flashes of light
  - Sparks of light
  - "snap" and "clap" of laser
- Length of procedure
- Importance of head position
- Risks and possible complications
- Contact lens insertion
- One eye at a time – 1 week apart
- Presence of floaters initially until tissue settles

YAG Cap Techniques

- Power/Energy settings vary with lasers (.8 to 2.0mj)
- Spot size is fixed
- Duration is fixed
- Pulse setting recommended at 1
- Offset of Laser
  - Purpose is to set the place of treatment relative to the energy level and position of the aiming laser HeNe beams
  - The greater the power, the greater the offset needed
  - Each laser is different – our laser offset of +2.50, and push towards the retina a little.

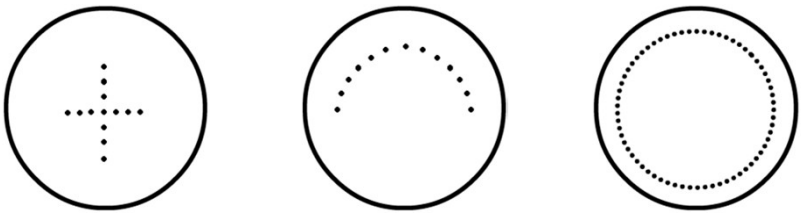
YAG Cap Techniques

- Focus HeNe beam
- Push in towards the retina, position the beams behind the posterior capsule

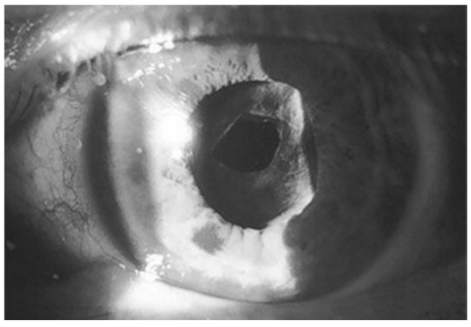


YAG Cap Techniques

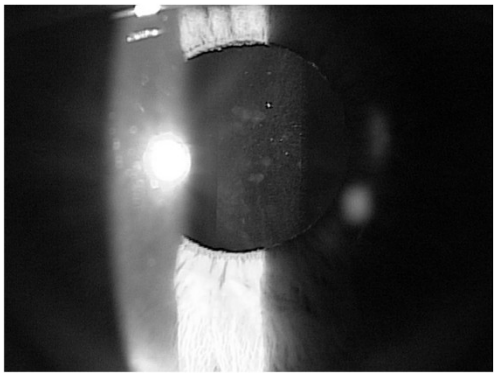
- Initial shot (central pilot mark)
- Cruciate pattern – most common & effective. Start at center, move along the horizontal then downwards
- Other Patterns
  - Horseshoe
  - Circular



YAG Cap Techniques

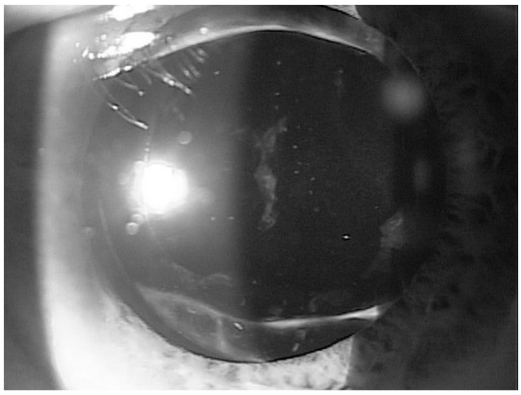


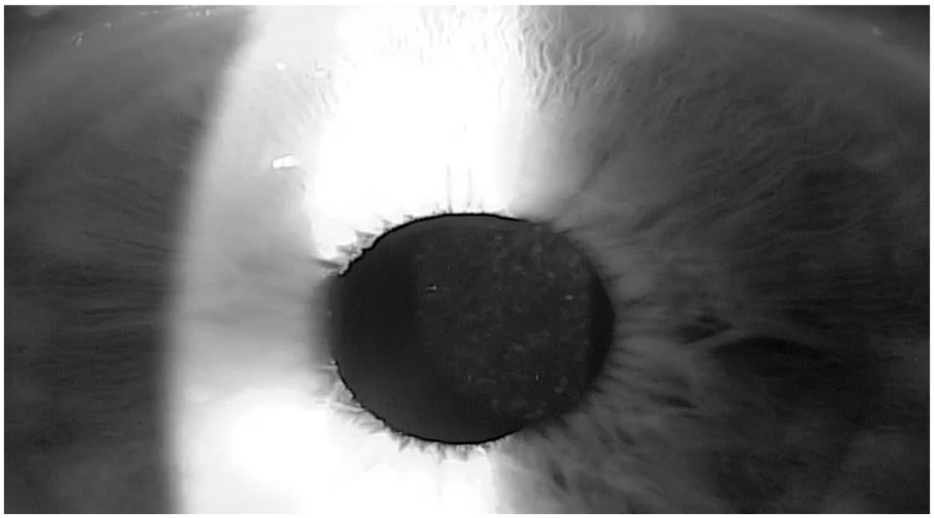
M.L. OS

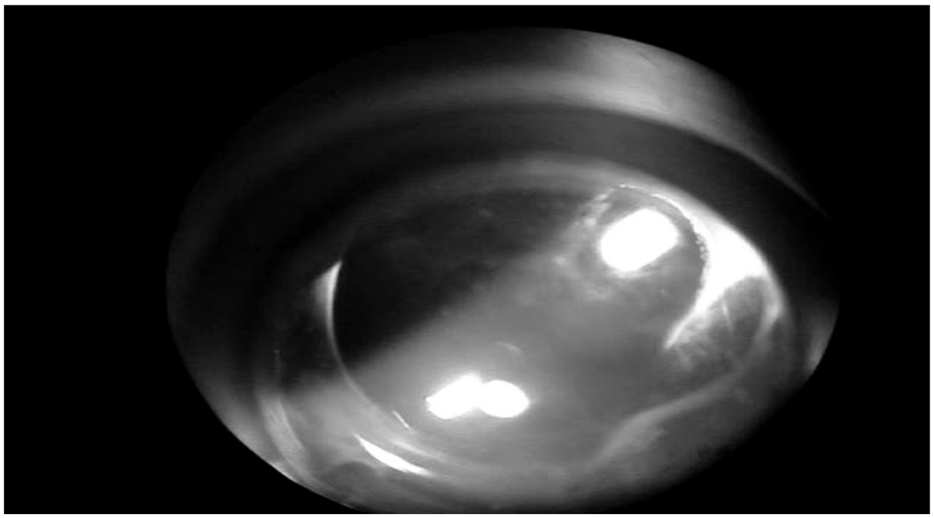


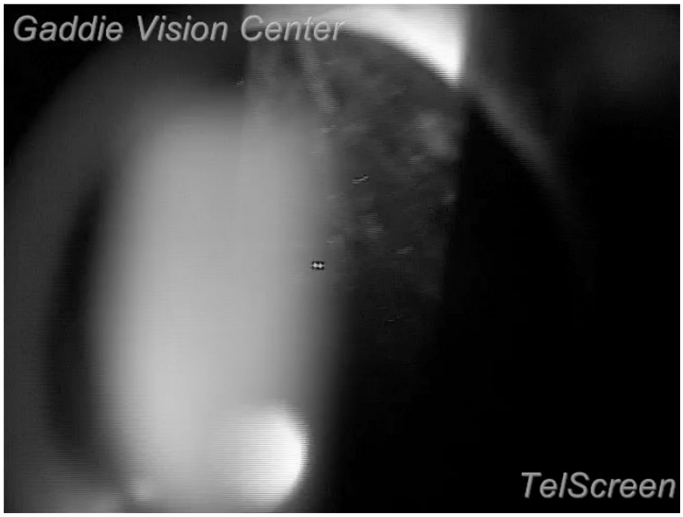
PRE

POST








Gaddie Vision Center
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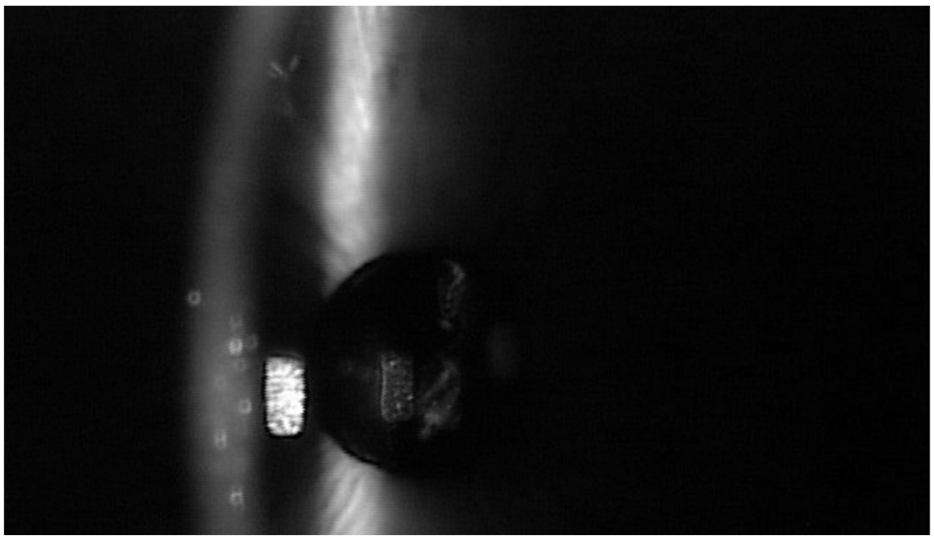
Residual Capsule after Laser



Post-Operative Management

- Patient education
- Topical steroid – Pred Forte QID x 1 week
- Topical IOP control medication
  - 1% Iopidine, recheck IOP 1 hr. post-op
- Continue all pressure lowering medications
- Common RTC 1 week for follow up
  - Acuity & IOP check, DFE

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- **Feldman RM et al. Long-term efficacy of repeat argon laser trabeculoplasty. 1991: 1061-5.**
- **Odberg T et al. The medium and long-term efficacy of primary argon laser trabeculoplasty in avoiding topical medication in open angle glaucoma. Acta Ophthalmol Scand 1999;176-81>**
- **NIH/NEI Trials: http://www.nei.nih.gov/ (Glaucoma Laser Trial, Glaucoma Laser Trial Followup Study, Advanced Glaucoma Intervention Study)**
- **Ren J et al. Efficacy of apraclonidine 1% vs pilocarpine 4% for prophylaxis of IOP spike after ALT. Ophthalmology 1999:1135-9.**

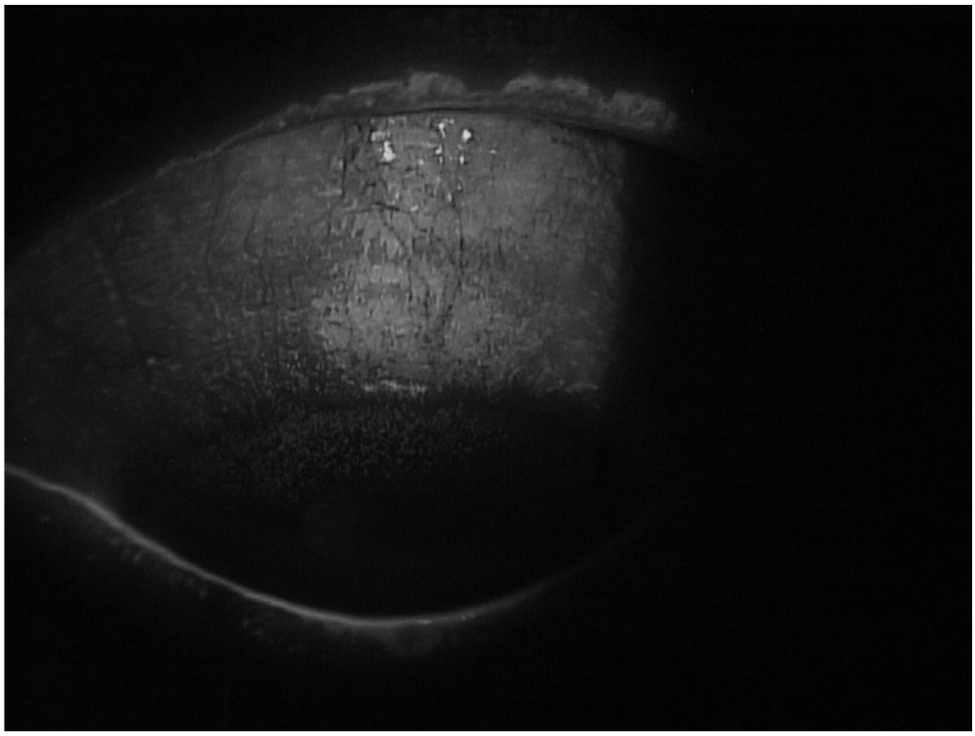
SLK Treatment

Low Temperature Cautery

- Povidone Iodine wipes
- Antibiotic drops x 3 - separated by 3 minutes apart
- Chlorprocaine 3 drops 3 minutes apart
- Rows of 5 Spots

2 week follow-up Visit: Patient wanted to treat OD next day!

SLK



A Medscape LIVE! CONFERENCE

THANK YOU