Maine Society of
Eye Physicians & Surgeons

GATT:
The Cost-effective MIGS

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Financial disclosures

- Aerie Pharm: S
- Allergan: C, S, R
- CATS: M
- MicroOptx: M
- New World Medical: C, S, R
- Nova Eye Medical: S, E
- Olleyes: C, E
- Reichert: C, S
- Sanoculis: M
- Santen: C
- Surgical Specialties: S

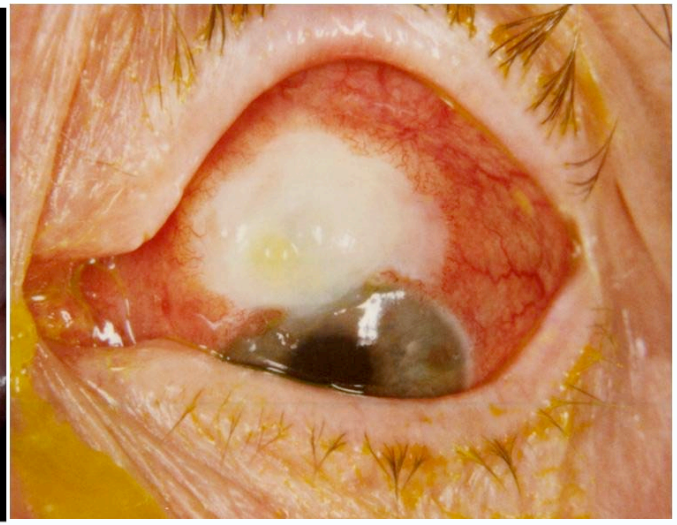
- C: consultant
- E: equity
- M: medical advisory board
- R: research support
- S: speaker

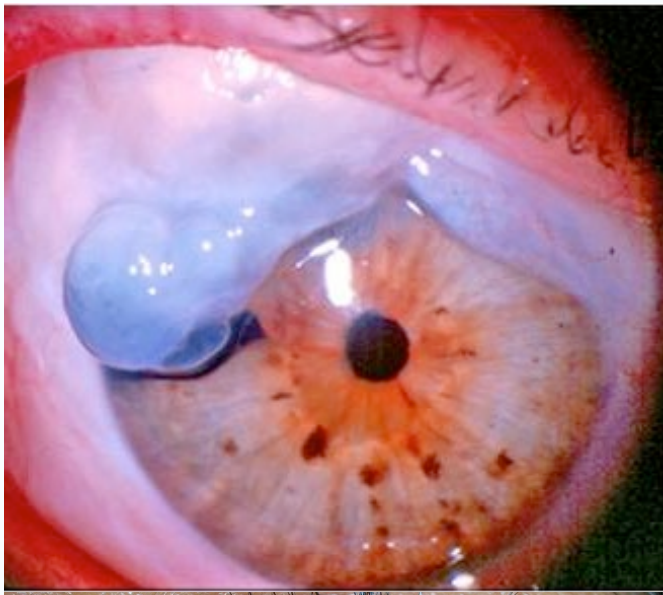
Outline

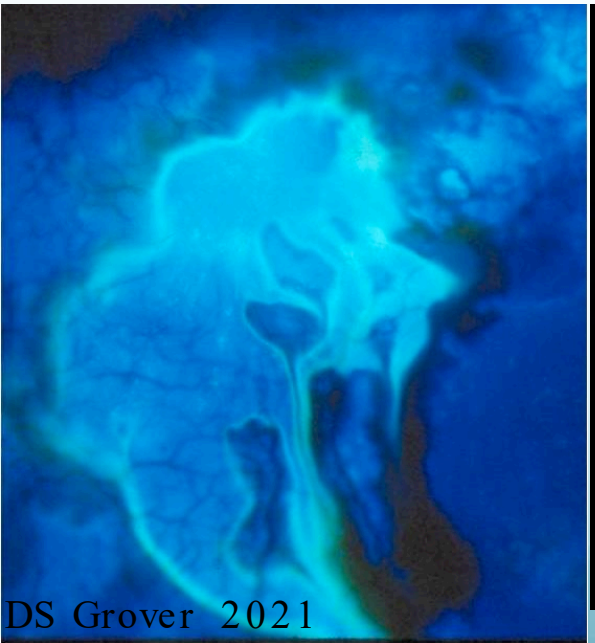
- Overview of my Glaucoma Surgical Algorithm
- GATT
  - Introduction
  - Data
  - Cost Implications
- Basic Video
- Instruments and Supplies that I use
- “Indications”
- Conclusion and Future Implications

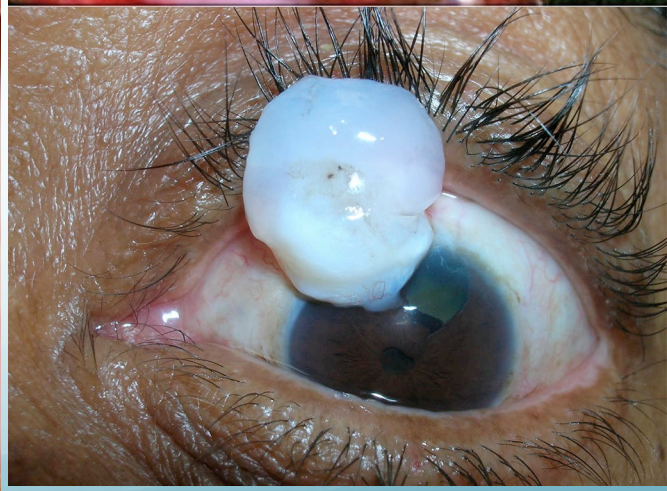
What's wrong with the Current Standard of Care?

Bad Blebs









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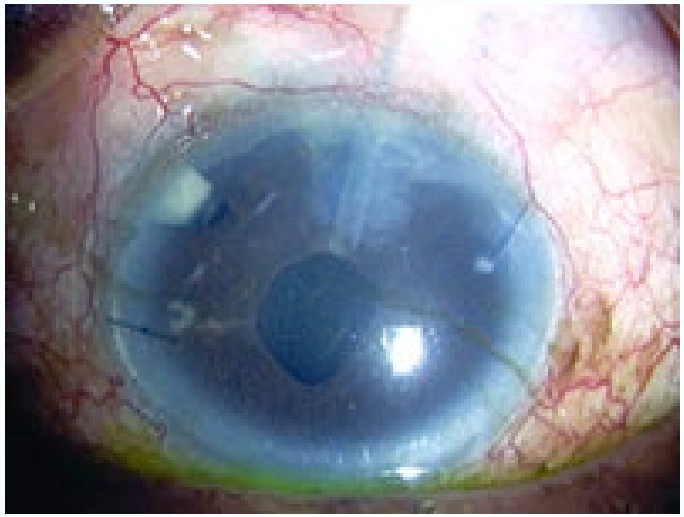
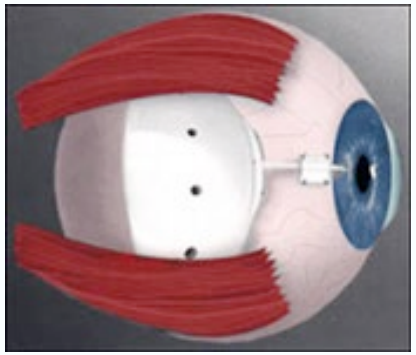
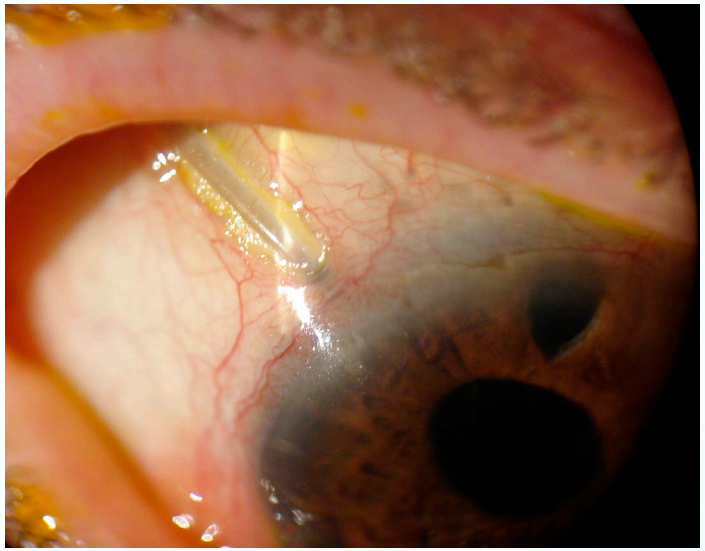
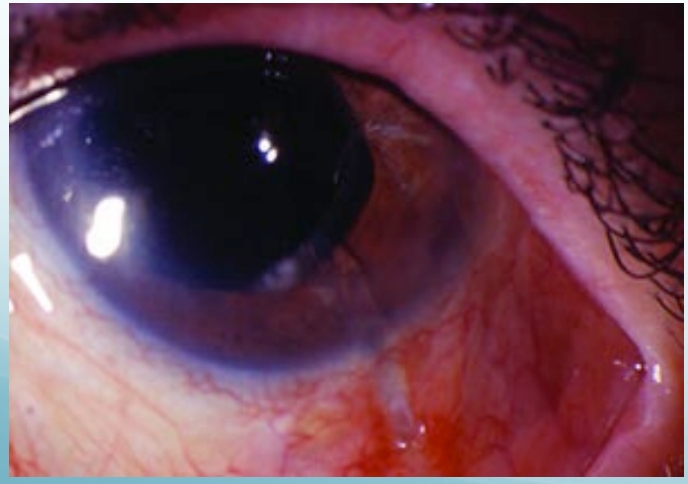
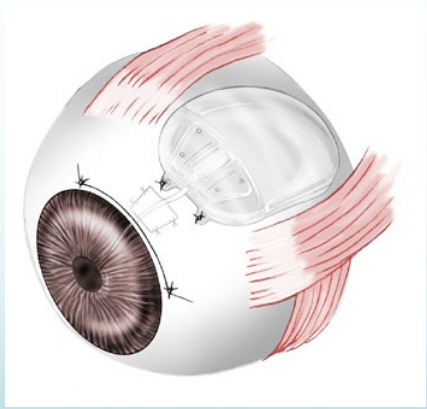
Bad Tubes

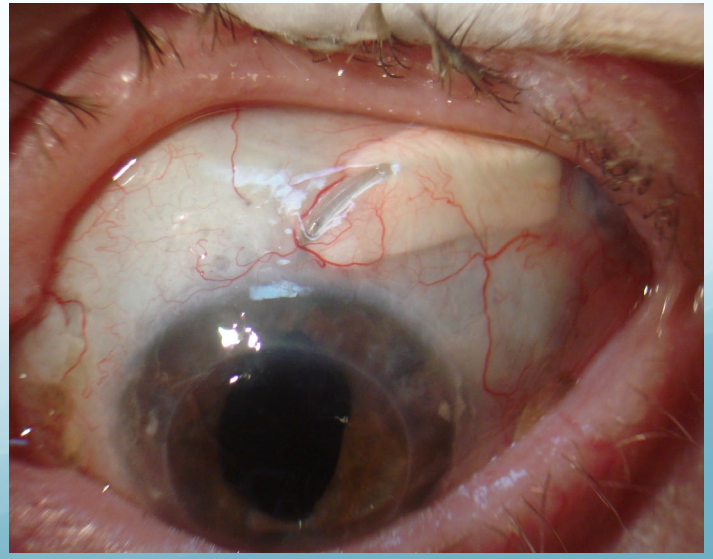


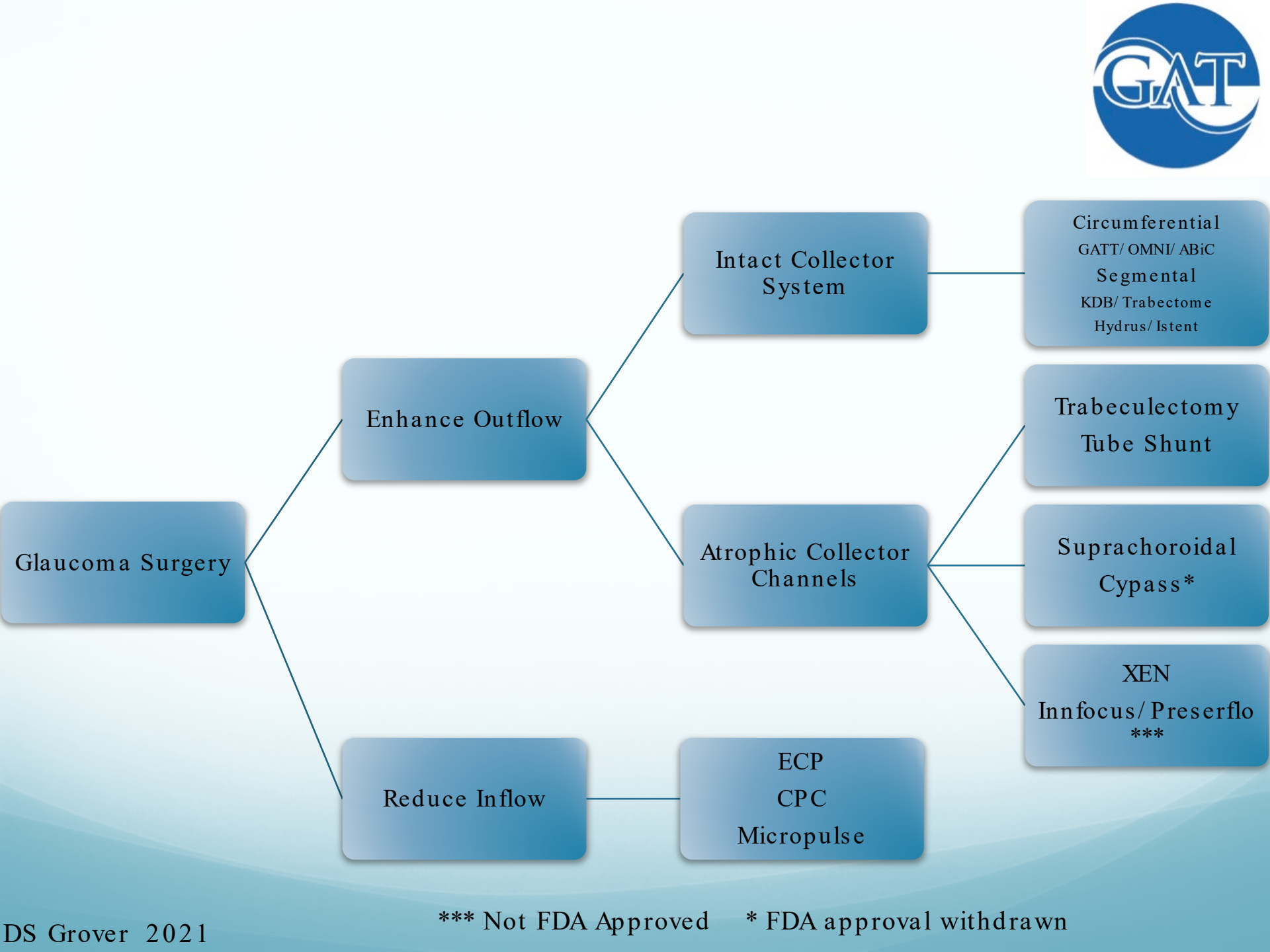












*** Not FDA Approved * FDA approval withdrawn

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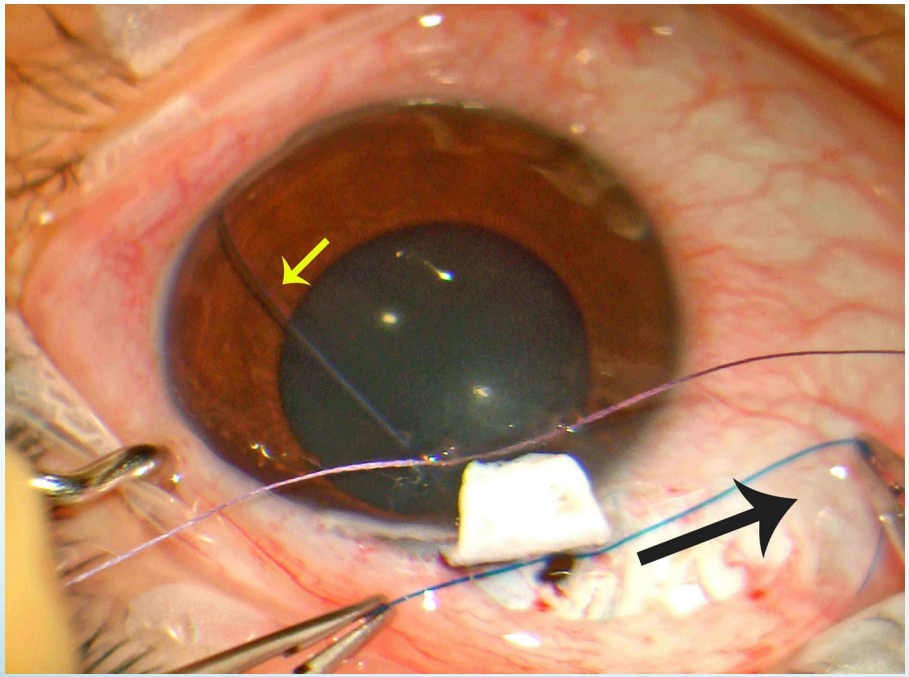
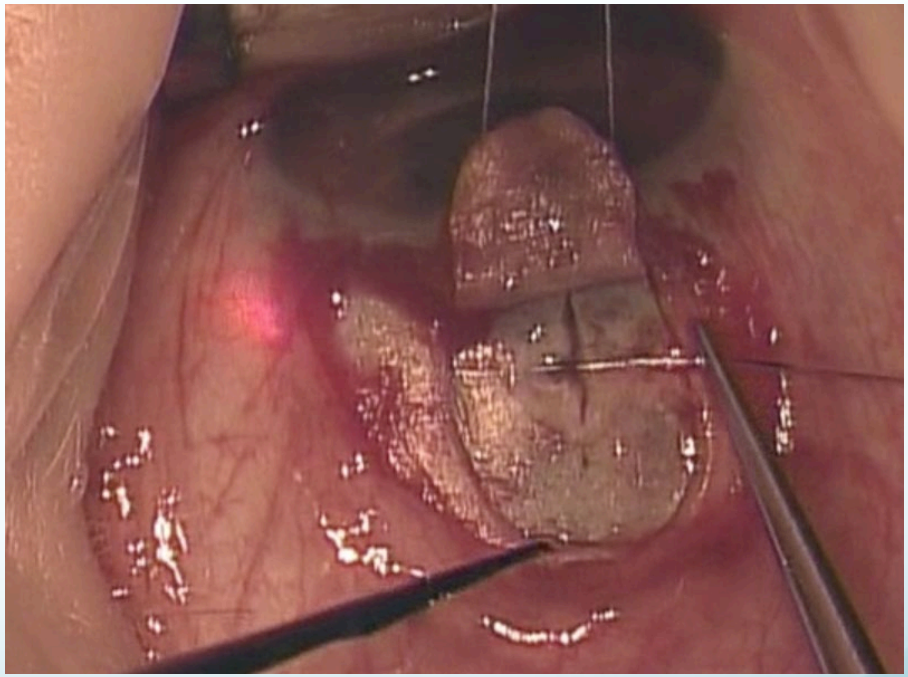
Overview of Trabeculotomy





Nylon Filament Trabeculotomy.
Comparison with the results of conventional drainage operations in glaucoma simplex

REDMOND SMITH *(London)* 1969

Transactions of the Ophthalmological Society of New Zealand

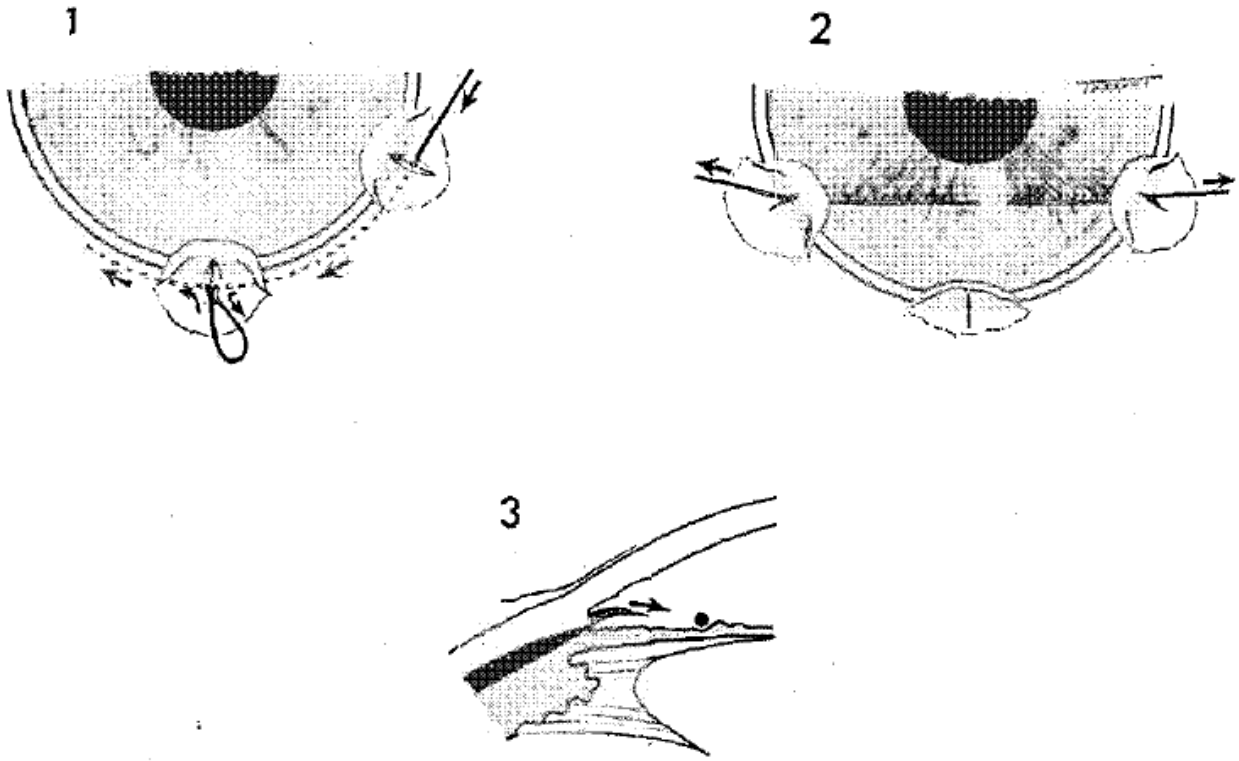


FIG. 1 (a)—Diagram to show the technique of nylon filament trabeculotomy.

Why Trabeculotomy in Adults?

- Landmark article: M Grant: "Further studies on facility of flow through the trabecular meshwork. Arch of Ophthalmology, 60:523, 1958
  - "three-fourths of the resistance to outflow in the enucleated human eye could be eliminated by creating an opening between the anterior chamber and Schlemm's canal."

Long-term Outcome of Trabeculotomy for the Treatment of Developmental Glaucoma

Hanako Ikeda, MD; Hitoshi Ishigooka, MD; Tomoyuki Muto, MD; Hidenobu Tanihara, MD; Makoto Nagata, MD

Arch Ophthalmol. 2004;122:1122-1128

- Retrospective review of 149 eyes
- Ab externo trabeculotomies
- Mean +/- SD follow up time: 9.5 +/- 7.1 years
- Mean +/- SD IOP at last follow up: 15.6 +/- 5.0
- Success rate of nearly 90%

Surgical Effects of Trabeculotomy Ab Externo on Adult Eyes With Primary Open Angle Glaucoma and Pseudoexfoliation Syndrome

Hidenobu Tanihara, MD; Akira Negi, MD; Masayuki Akimoto, MD; Hiroshi Terauchi, MD; Akihisa Okudaira, MD; Iun Kozaki, MD; Atsushi Takeuchi, MD; Makoto Nagata, MD

(Arch Ophthalmol. 1993;111:1653-1661)

Table 2. Success Probabilities and the Number of Eyes—Retrospective Study

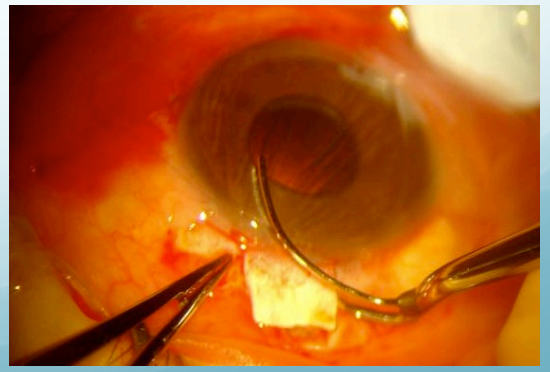
Follow-up	No. of Eyes	Success Probability, %*
Primary Open Angle Glaucoma		
Preoperative	357	. . .
Year 1	242	76.4±2.3
Year 2	144	64.7±2.7
Year 3	107	62.7±2.8
Year 4	93	60.8±2.9
Year 5	72	58.0±3.1
Pseudoexfoliation Syndrome		
Preoperative	82	. . .
Year 1	53	83.6±4.3
Year 2	35	80.0±4.9
Year 3	26	77.4±5.3
Year 4	21	77.4±5.3
Year 5	18	73.5±6.3

Success Rates of Trabeculotomy for Steroid-Induced Glaucoma: A Comparative, Multicenter, Retrospective

KEIICHIRO IWAO, MASARU INATANI, AND HIDENOBU TANIHARA, ON BEHALF OF THE JAPANESE STEROID-INDUCED GLAUCOMA MULTICENTER STUDY GROUP

Am J Ophthalmol 2011;151: 1047–1056.

- Purpose: evaluate surgical outcomes of trabeculotomy in steroid induced glaucoma
- Design: Multicenter retrospective study
- Methods: Compared 121 eyes with steroid induced glaucoma that underwent a trabeculotomy with 108 POAG eyes and 42 eyes with Steroid induced glaucoma
- Results:
  - 3 year probability of success
    - Trabeculectomy group: 55.8 %
    - Trabeculotomy group: 78.1%

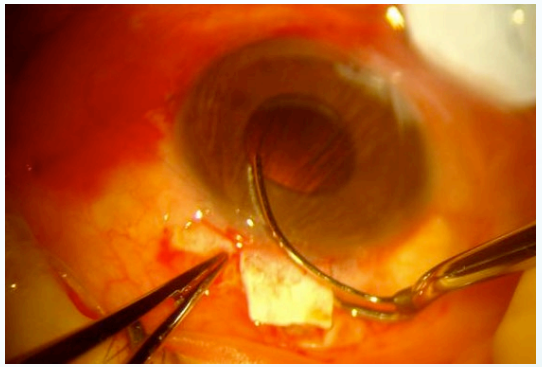


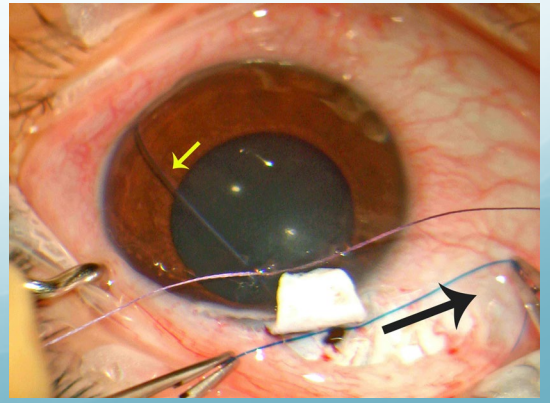
Reduction of Intraocular Pressure Using a Modified 360-degree Suture Trabeculotomy Technique in Primary and Secondary Open-Angle Glaucoma: A Pilot Study

Shinki Chin, PhD, MD, Takuya Nitta, PhD, MD, Yasuhiro Shinmei, PhD, MD, Maiko Aoyagi, MD, Akari Nitta, MD, Shigeaki Ohno, PhD, MD, Susumu Ishida, PhD, MD, and Kazuhiko Yoshida, PhD, MD

J Glaucoma 2012;21:401–407

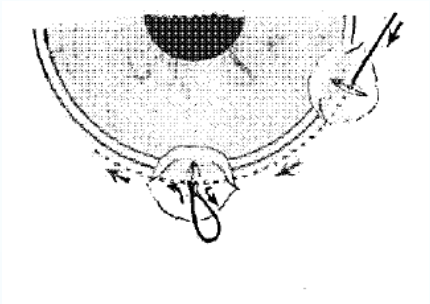
- Purpose: Compare a modified technique for 360-degree suture trabeculotomy with a trabeculotomy performed using metal trabeculotomes
- Method: Retrospective comparative chart review
- Results:
  - Success rates at 12 months for POAG
    - 360 trabeculotomy: 84% (Mean IOP 13.1 mmHg)
    - Metal trabeculotome: 31% (Mean IOP 15.2 mmHg)
  - Success rates at 12 months for SOAG
    - 360 trabeculotomy: 89%
    - Metal trabeculotome: 50%

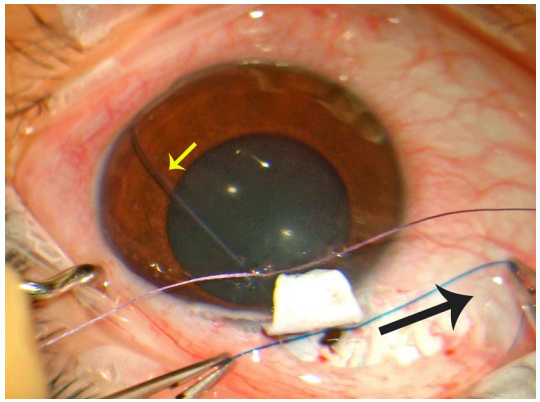




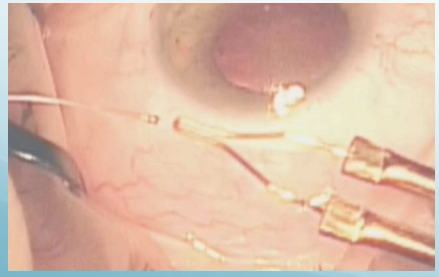
Problems with Trabeculotomy Ab Externo

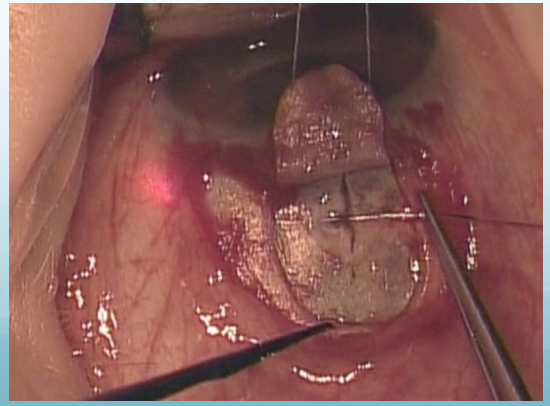
- Length of time (30-60+ minutes)
- Numerous Conjunctival and Scleral sutures required
- Violate the conjunctiva
  - May preclude or diminish success rates for a subsequent trabeculectomy
- Relatively invasive





The Evolution of Trabeculotomy in Adults





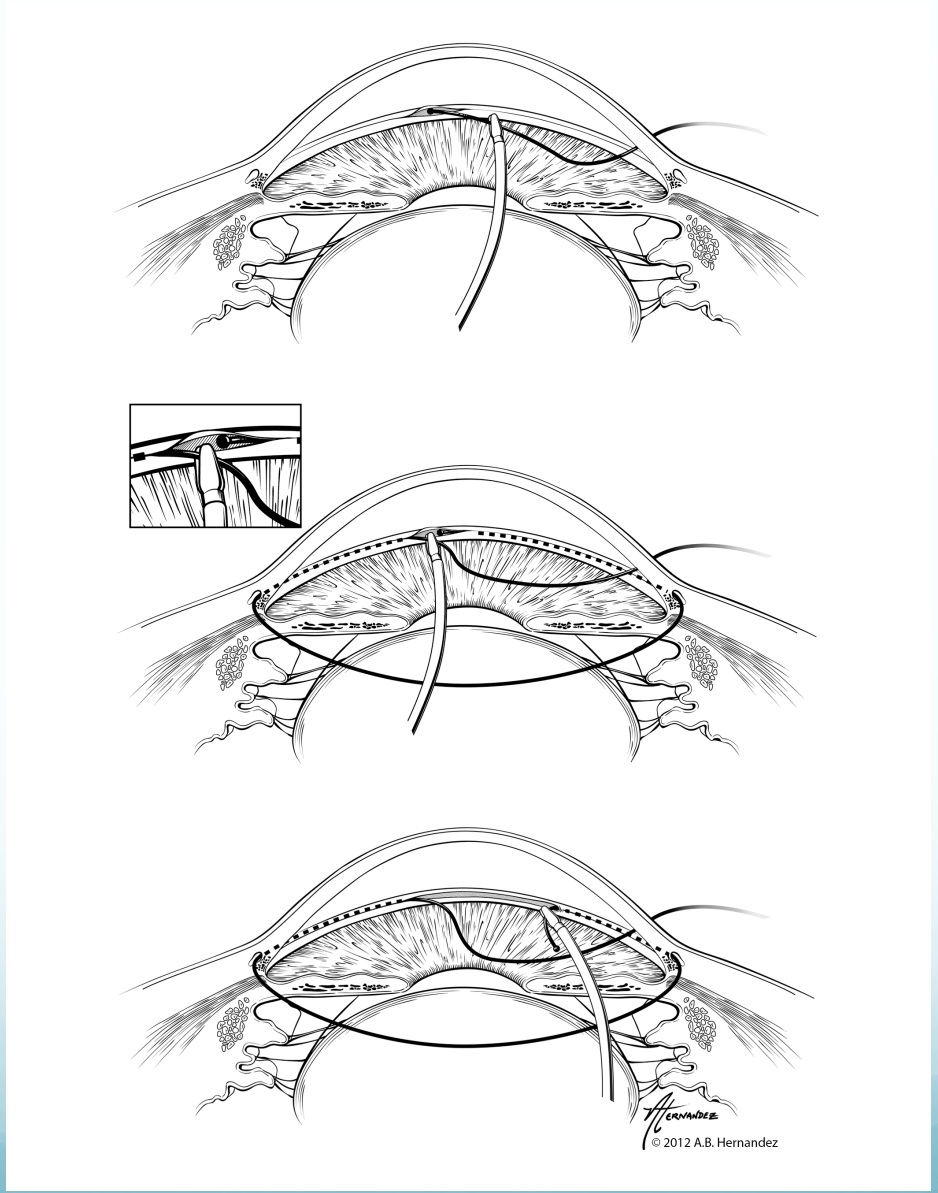
360 Degree Ab Interno Trabeculotomy with a Suture

AKA

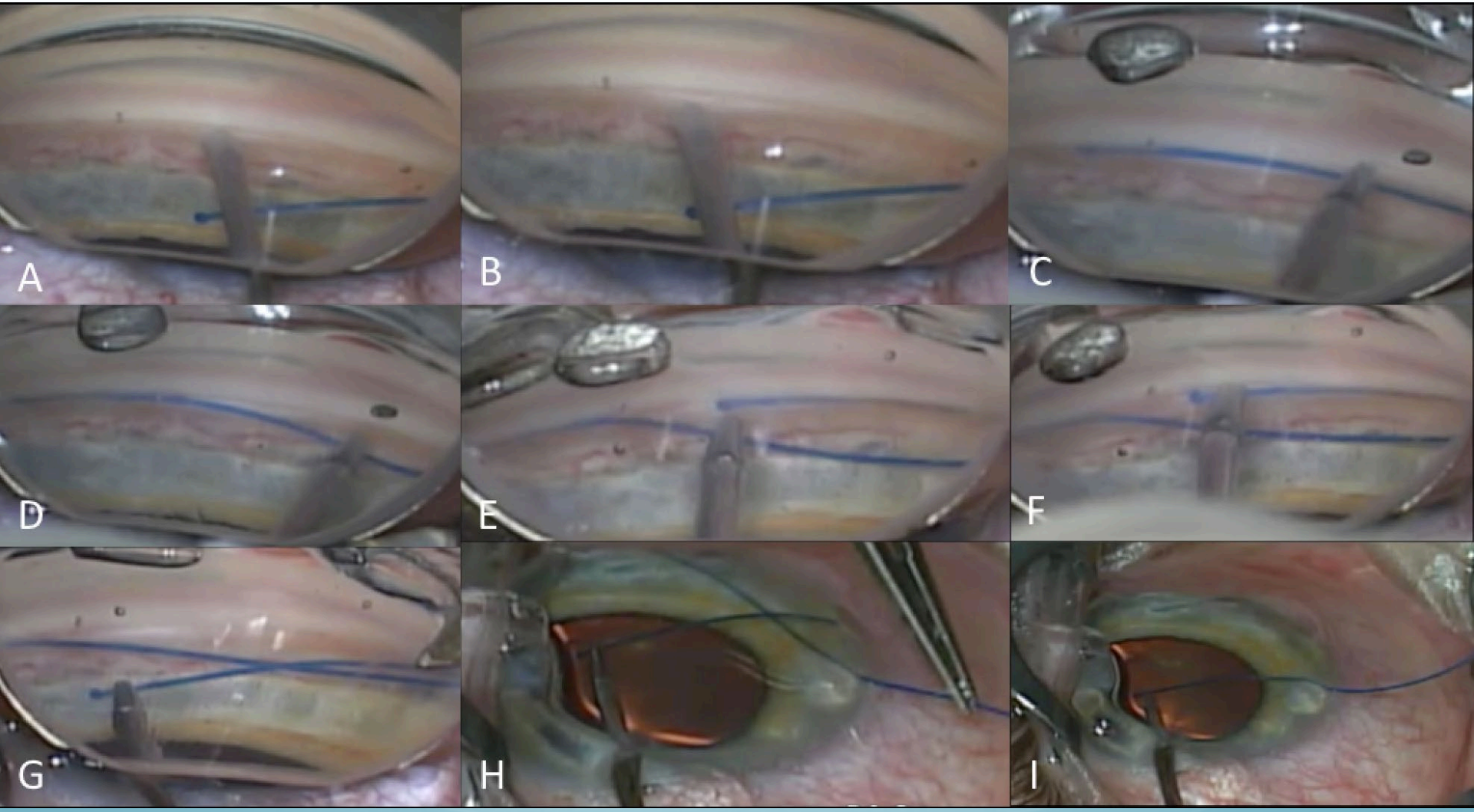
GATT Procedure

(Gonioscopy Assisted Transluminal Trabeculotomy)

GATT



5-0 Prolene Suture GATT



GATT video

Gonioscopy-Assisted Transluminal Trabeculotomy, Ab Interno Trabeculotomy

Technique Report and Preliminary Results

Ophthalmology 2014;121:855-861

Davinder S. Grover, MD, MPH,[1] David G. Godfrey, MD,[1] Oluwatosin Smith, MD,[1] William J. Feuer, MS,[2] Ildamaris Montes de Oca, MD,[3] Ronald L. Fellman, MD[1]

- 85 eyes of 85 patients underwent the GATT procedure with at least 6 months follow-up
  - In bilateral cases, one eye was randomly excluded
- 57 patients with POAG
  - 12 months follow up:
    - IOP decreased by 11.1mm Hg (SD=6.1)
    - 1.1 fewer glaucoma medications at 12 months.
- 28 patients with secondary glaucoma
  - 12 months:
    - IOP decreased by 19.9 mm Hg (SD=10.2)
    - 1.9 fewer medications
- The cumulative proportion of failure at 1 year ranged from 0.1 to 0.32, depending on the group.

Gonioscopy assisted transluminal trabeculotomy: an ab interno circumferential trabeculotomy for the treatment of primary congenital glaucoma and juvenile open angle glaucoma

Davinder S Grover,[1] Oluwatosin Smith,[1] Ronald L Fellman,[1] David G Godfrey,[1] Michelle R Butler,[1] Ildamaris Montes de Oca,[2] William J Feuer[3]

Grover DS, *et al*. *Br J Ophthalmol* 2015;**0**:1–5. doi:10.1136/bjophthalmol-2014-306269

- Retrospective Chart review of patients < 30 years old with a dysgenic anterior segment angle and uncontrolled PCG or JOAG
- 14 eyes of 10 patients underwent a GATT with >12 months follow up.
- Age range 17 months to 30 years
- Mean decrease in IOP from 27.3 to 14.8mmHg
- Mean decrease in meds from 2.6 to 0.86

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Gonioscopy-assisted Transluminal Trabeculotomy: An Ab Interno Circumferential Trabeculotomy: 24 Months Follow-up

Davinder S. Grover, MD, MPH, Oluwatosin Smith, MD,* Ronald L. Fellman, MD,* David G. Godfrey, MD,* Aditi Gupta, MD,* Ildamaris Montes de Oca, MD,† and William J. Feuer, MS‡*

J Glaucoma • Volume 27, Number 5, May 2018

- GATT participants 198 eyes of 198 patients with preoperative IOP ≥ 18mmHg
- No prior IOP lowering surgery.
- Focusing on 18 - 24 month follow up

Variable	POAG	POAG Combined	POAG Prior CE	Other	Other Combined	Other Prior CE
Female, n (%)	23 (50%)	21 (58%)	22 (60%)	11 (37%)	13 (52%)	13 (54%)
Ethnicity, n (%) White Black Hispanic Other	 24 (52%) 17 (37%) 5 (11%) 0	 27 (75%) 7 (19%) 0 2 (6%)	 25 (68%) 9 (24%) 2 (5%) 1 (3%)	 18(60%) 6 (20%) 5 (17%) 1 (3%)	 23 (92%) 0 1 (4%) 1 (4%)	 20 (83%) 1 (4%) 2 (8%) 1 (5%)
Right eye operated, n (%)	26 (57%)	19 (53%)	19 (51%)	16 (53%)	13 (52%)	12 (50%)
Age, Mean (SD) [min, max]	59 (9) [40, 83]	73 (7) [60, 87]	75 (9) [50, 89]	49 (13) [24, 68]	69 (9) [45, 87]	65 (14) [29, 86]
Diagnosis, n (%) POAG CACG PXF PigDisp Uveitic MM Other OAG Trauma Steroid	 46 (100%)	 36 (100%)	 37 (100%)	 2 (7%) 4 (13%) 5 (17%) 4 (13%) 5 (17%) 1 (3%) 7 (23%) 2 (7%)	 2 (8%) 11 (44%) 4 (16%) 2 (8%) 3 (12%) 3 (12%)	 3 (13%) 3 (13%) 3 (13%) 7 (29%) 3 (13%) 5 (21%)
HVF MD Mean (SD) [min, max] (p=0.14)	-8.5 (8.4) [-29, 1]	-6.5 (7.4) [-24, 1]	-10.9 (7.8) [-26, 1]	-10.5 (9.6) [-31, 0]	-11.8 (9.4) [-29, -1]	-9.6 (8.5) [-31, 1]

Pre-operative Characteristics

Variable	POAG	POAG Combined	POAG Prior CE	Other	Other Combined	Other Prior CE
Pre-Op IOP (mmHg), Mean (SD),	26.0 (6.9)	22.5 (5.4)	24.7 (6.2)	30.9 (10.0)	25.7 (6.3)	26.6 (7.9)
Pre-Op # meds, Mean (SD)	3.2 (1.1)	2.9 (1.1)	2.6 (1.1)	3.6 (1.2)	3.0 (1.3)	3.5 (0.8)
HVF MD Mean (SD) [min, max] (p=0.14)	-8.5 (8.4) [-29, 1]	-6.5 (7.4) [-24, 1]	-10.9 (7.8) [-26, 1]	-10.5 (9.6) [-31, 0]	-11.8 (9.4) [-29, -1]	-9.6 (8.5) [-31,1]

Follow Up	POAG	POAG Combined	POAG Prior CE	Other	Other Combined	Other Prior CE
Months followed Mean (SD) [range]	24.6 (6.1) [6-33]	24.5 (5.1) [6-31]	25.5 (6.4) [9-35]	25.5 (6.3) [6-32]	22.8 (6.4) [8-36]	25.7 (7.0) [9-43]
N (%) requiring further IOP lowering surgery	15 (33%)	3 (8%)	16 (43%)	9 (30%)	4 (16%)	4 (17%)
N (%) of patients at each follow up visit						
Baseline	46 (100%)	36 (100%)	37 (100%)	30 (100%)	25 (100%)	24 (100%)
3 Mo	42 (91%)	34 (94%)	34 (92%)	28 (93%)	23 (92%)	22 (92%)
6 Mo	39 (85%)	34 (94%)	34 (92%)	28 (93%)	22 (88%)	23 (96%)
12 Mo	36 (78%)	33 (92%)	29 (78%)	25 (83%)	20 (80%)	18 (75%)
18 Mo	32 (70%)	32 (89%)	22 (60%)	21 (70%)	17 (68%)	20 (83%)
24 Mo	26 (57%)	27 (75%)	19 (51%)	19 (63%)	13 (52%)	17 (71%)
IOP, Mean (SD),						
Pre-op	26.0 (6.9)	22.5 (5.4)	24.7 (6.2)	30.9(10.0)	25.7 (6.3)	26.8 (7.9)
3 Mo	18.5 (7.7)	13.9 (4.1)	16.6 (4.6)	14.1 (4.9)	16.4 (8.2)	14.3 (3.6)
6 Mo	18.3 (6.8)	14.7 (5.3)	17.1 (6.3)	14.4 (3.7)	15.8 (8.4)	14.8 (7.0)
12 Mo	16.4 (6.4)	15.2 (4.3)	16.3 (4.4)	14.5 (5.1)	14.1 (2.9)	12.2 (2.8)
18 Mo	17.1 (6.7)	15.3 (4.1)	15.1 (2.9)	15.0 (5.4)	14.5 (4.9)	12.2 (3.5)
24 Mo	15.6 (5.7)	14.1 (3.2)	15.8 (7.4)	13.8 (4.5)	14.5 (4.4)	13.4 (4.7)
# meds, Mean (SD)						
Pre-op	3.2 (1.1)	2.9 (1.1)	2.6 (1.1)	3.6 (1.2)	3.0 (1.3)	3.5 (0.8)
3 Mo	1.6 (1.4)	0.7 (1.0)	1.0 (1.1)	1.3 (1.3)	1.0 (1.3)	1.5 (1.1)
6 Mo	1.7 (1.5)	0.8 (1.2)	1.2 (1.2)	1.2 (1.2)	1.0 (1.2)	1.6 (1.1)
12 Mo	1.9 (1.6)	0.7 (1.0)	1.7 (1.3)	1.5 (1.5)	0.9 (1.3)	1.6 (1.1)
18 Mo	1.7 (1.6)	0.8 (1.1)	1.6 (1.3)	1.5 (1.6)	1.1 (1.5)	1.3 (1.2)
24 Mo	1.8 (1.5)	1.0 (1.1)	1.6 (1.4)**	1.6 (1.8)	1.2 (1.6)	1.4 (1.1)

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Complications

More outcomes data on GATT
(>20 peer reviewed publications)

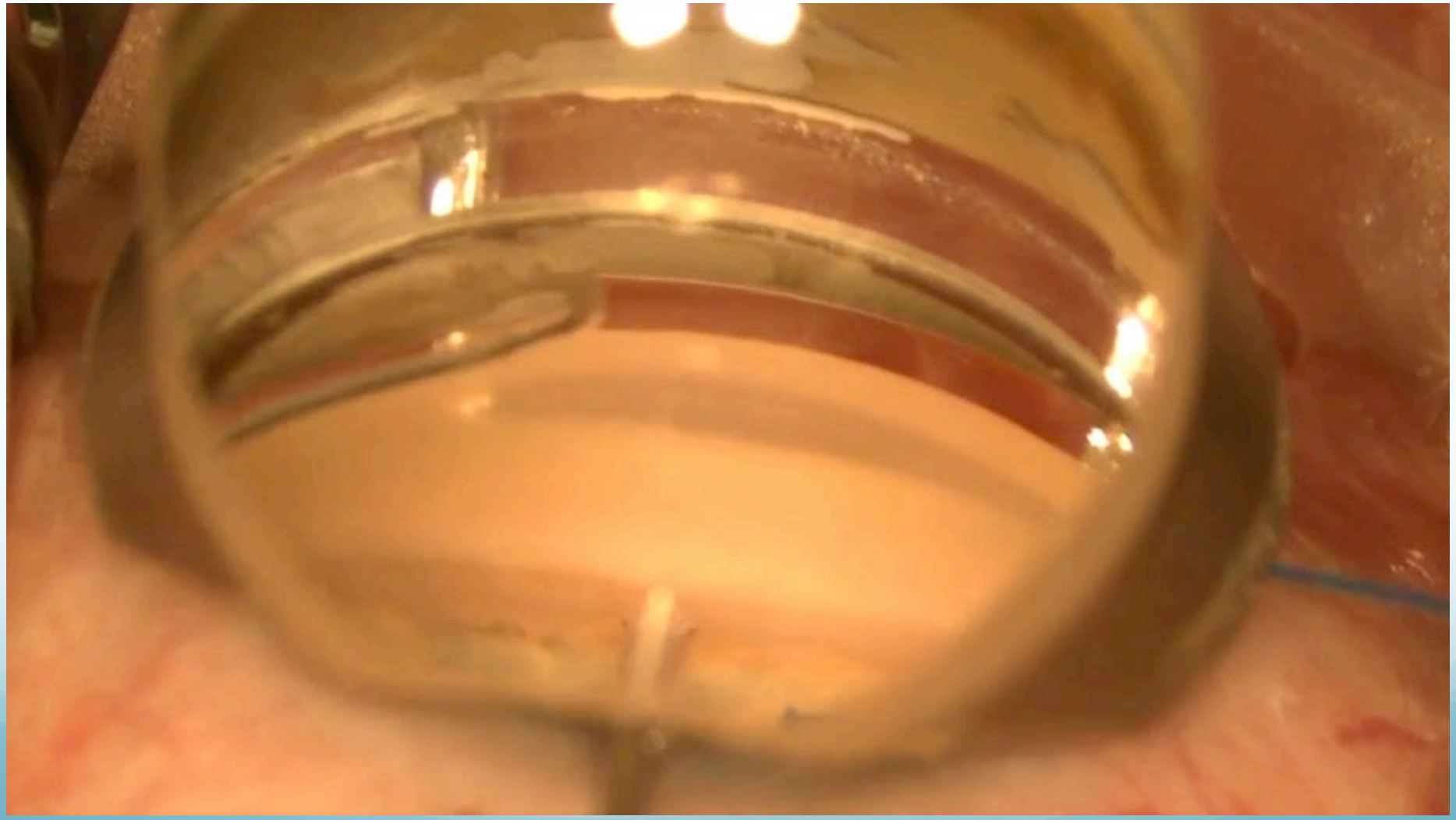
- Aktas Z, Ucgul AY, Bektas C et al. "Surgical Outcomes of Prolene Gonioscopy-assisted Transluminal Trabeculotomy in Patients With Moderate to Advanced Open-Angle Glaucoma." J Glaucoma. 2019 Oct;28(10):884-888
- Aktas Z, Ozmen MC, Atalay HT et al. "Evaluation of episcleral venous fluid wave during gonioscopy assisted transluminal trabeculotomy in patients with advanced glaucoma." Eye (Lond). 2019 Apr;33(4):668-673
- Boese EA, Shah M. "Gonioscopy-assisted Transluminal Trabeculotomy (GATT) is An Effective Procedure for Steroid-induced Glaucoma." J Glaucoma. 2019 Sep;28(9):803-807
- Baykara M, Poroy C, Erseven C. "Surgical outcomes of combined gonioscopy-assisted transluminal trabeculotomy and cataract surgery." Indian J Ophthalmol. 2019 Apr;67(4):505-508
- Aktas Z, Ozmen MC, Atalay HT et al. "Evaluation of episcleral venous fluid wave during gonioscopy assisted transluminal trabeculotomy in patients with advanced glaucoma." Eye (Lond). 2019 Apr;33(4):668-673
- Grover DS, Smith O, Fellman RL et al. "Gonioscopy-assisted Transluminal Trabeculotomy: An Ab Interno Circumferential Trabeculotomy: 24 Months Follow-up. J Glaucoma. 2018 May;27(5):393-401
- Grover DS, Godfrey DG, Smith O et al. "Outcomes of Gonioscopy-assisted Transluminal Trabeculotomy (GATT) in Eyes With Prior Incisional Glaucoma Surgery." J Glaucoma. 2017 Jan;26(1):41-45
- Grover DS, Fellman RL. "Gonioscopy-assisted Transluminal Trabeculotomy (GATT): Thermal Suture Modification With a Dye-stained Rounded Tip." J Glaucoma. 2016 Jun;25(6):501-4.
- Grover DS, Smith O, Fellman RL et al. "Gonioscopy assisted transluminal trabeculotomy: an ab interno circumferential trabeculotomy for the treatment of primary congenital glaucoma and juvenile open angle glaucoma." Br J Ophthalmol. 2015 Aug;99(8):1092-6
- Grover DS, Godfrey DG, Smith O et al. "Gonioscopy-assisted transluminal trabeculotomy, ab interno trabeculotomy: technique report and preliminary results." Ophthalmology. 2014 Apr;121(4):855-61
- Guo CY, Qi XH, Qi JM. "Systematic review and Meta-analysis of treating open angle glaucoma with gonioscopy-assisted transluminal trabeculotomy." Int J Ophthalmol. 2020 Feb 18;13(2):317-324
- Olgun A, Aktas Z, Ucgul AY. „XEN gel implant versus gonioscopy-assisted transluminal trabeculotomy for the treatment of open-angle glaucoma." Int Ophthalmol. 2020 Jan 6.
- Rahmatnejad K, Pruzan NL, Amanullah S et al. "Surgical Outcomes of Gonioscopy-assisted Transluminal Trabeculotomy (GATT) in Patients With Open-angle Glaucoma." J Glaucoma. 2017 Dec;26(12):1137-1143

Intra-operative tricks

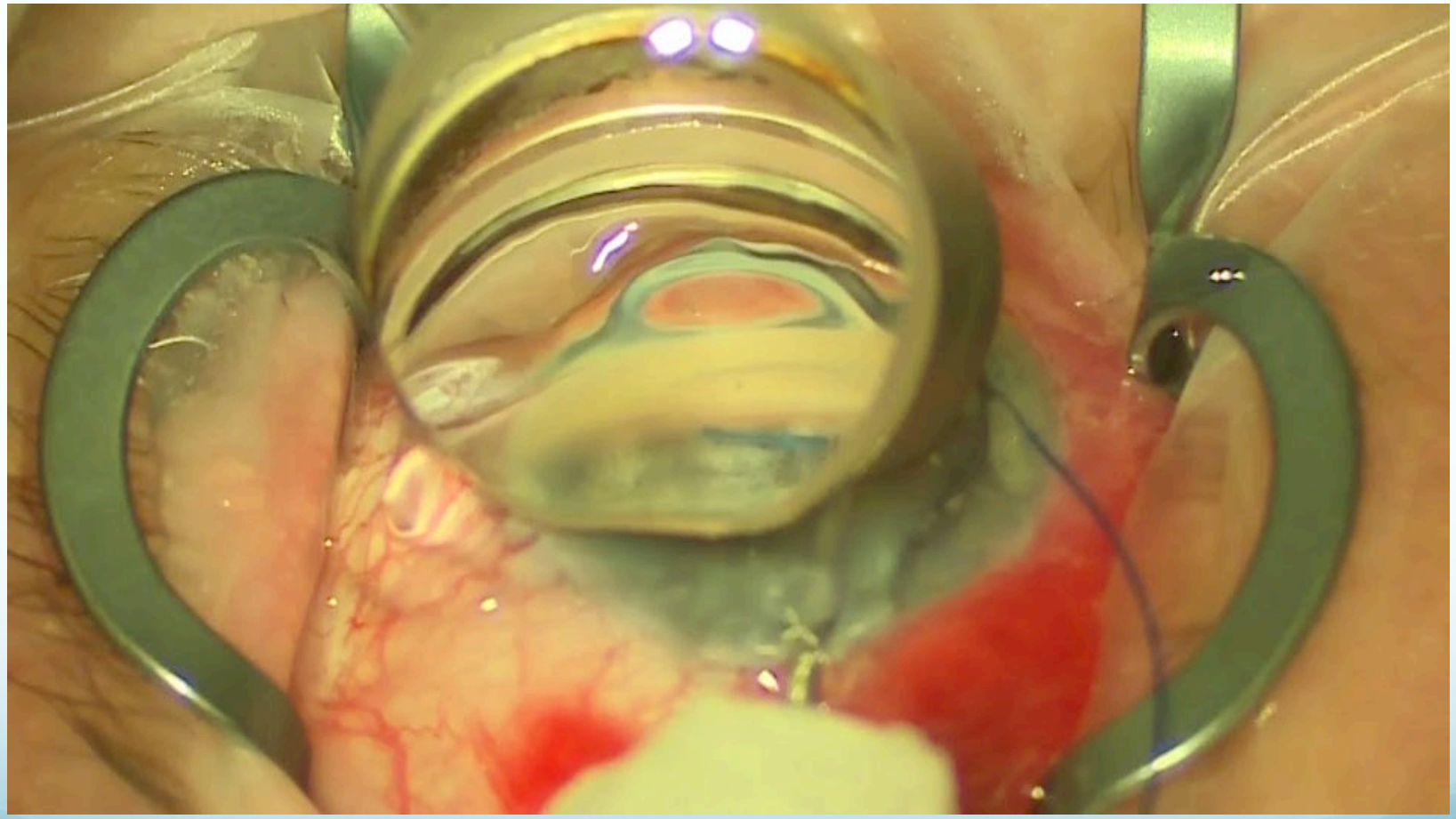
- What happens with intraoperative bleeding
- What happens when the suture stops
- What happens when the suture comes around 360 and……
  - Its not in the angle
  - You don't see it

Intraoperative Bleeding

When suture comes out of canal

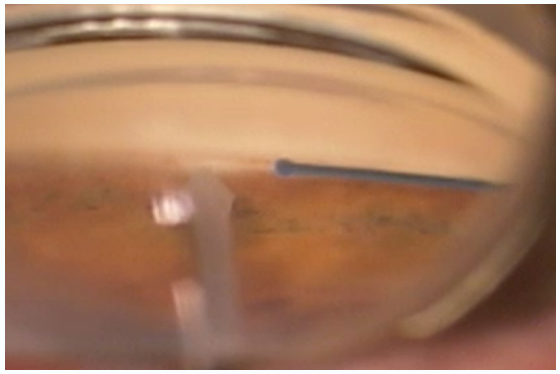


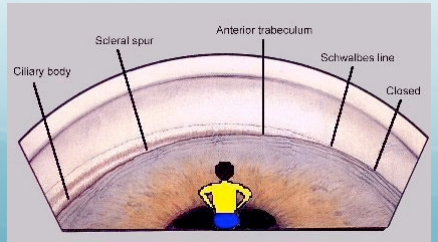
What Happens when suture stops?!



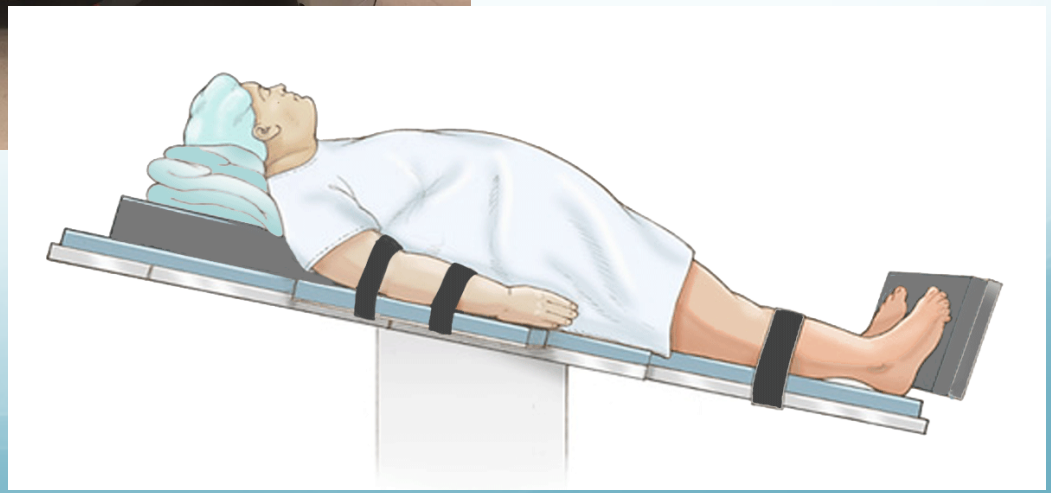
Surgical Pearls for Beginning Angle Surgeon

- Must know angle anatomy
- Practice performing intra-operative gonioscopy
  - After a phaco, place a Swann Jacob gonio prism on the eye and try to view the angle
- Performing istent, Tanito Goniotomy, KDB or Trabectome may be an easier first introduction to angle surgery
- Perform first case in pseudophakic patient
- Maintain AC at all times with visco-elastic
- Place patient in reverse Trendelenberg
  - Minimize EVP
  - Minimize blood reflux






stryker

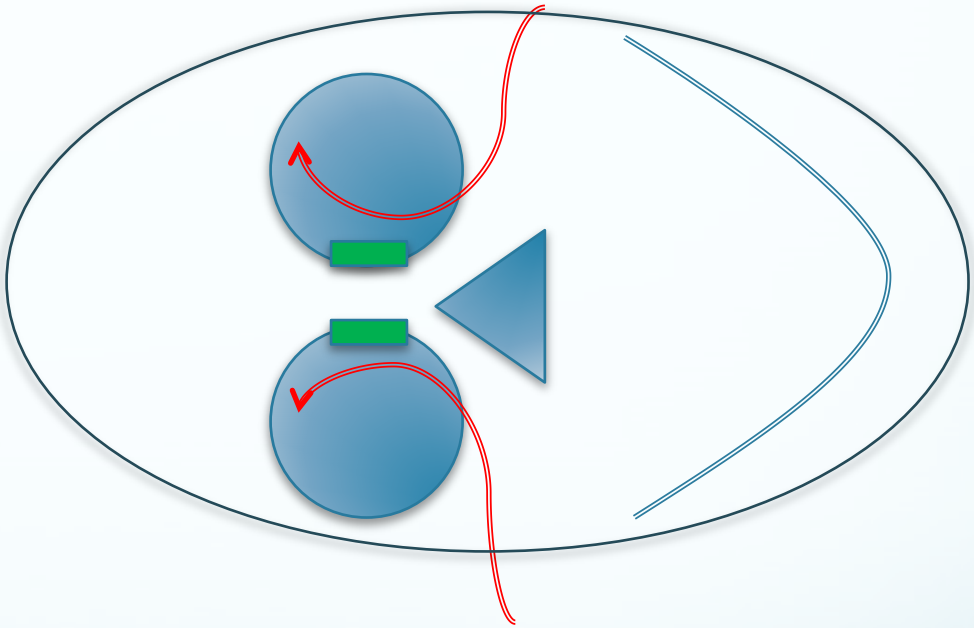


Basic Pearls for GATT

- Make the smallest blunt on the prolene tip as possible
- Keep the anterior chamber formed
  - Healon GV
- Always have a good view
- Be Gentle
- Place a small amount of healon on the gonio prism
- If you cannot see, use healon to push away blood
- If too much bleeding
  - Washout the entire a/c
  - Increase reverse trendelenburg

Surgical Pearls for Experienced Angle Surgeon

- Pass the suture from inferiorly to nasal
  - Counter clockwise for right eyes
  - Clockwise for left eyes
- Based on level of blood reflux and episcleral venous fluid wave, leave visco-elastic in the a/c
  - Greater wave and reflux
    - leave 30-40% healon fill
  - Minimal wave and reflux,
    - leave 0-10% healon fill
- If suture stops
  - Pull on proximal end and one will create a limited –otomy
  - Then pass suture in opposite direction to treat remaining angle



Suture vs Catheter

Suture

- Cost ~4 USD
- Less likely to kink
- Stronger
- Easier to push but requires more effort at the end

Catheter

- Cost > 750 USD
- Guide light help especially in PCG/ JOAG
- If kink, you're done
- Usually goes around the canal a bit easier

When I use GATT

- POAG
  - Mild/moderate stages
  - With or without PHACO
- SOAG
  - All stages
    - mild, moderate and advanced
  - With or without PHACO
- Patients with real glaucoma who need real IOP lowering
  - Not the OHTN on one med
- Best patients:
  - Mild/Mod POAG
  - Avastin induced glaucoma
  - PXF
  - Steroid induced glaucoma
  - NG Uveitics
  - Traumatic glaucoma
    - Once eye is quiet
  - PCG/JOAG
  - Newly diagnosed glaucoma
    - Eye hasn't been abused by gtts for decades

Patient Exclusion

- Advanced disease when patient doesn't have an intact collector system
- Patient needs an IOP of 12mmHg on no meds
- Cannot be taken off blood thinners for 1-2 weeks
- Cannot limit activity for 1-2 weeks
- Cannot sleep with HOB elevated
- Unstable IOL
- Broad areas of PAS

Post-op Regimen

- 1st week, antibiotics 4x/day and steroids 4-6x/day
- If IOP is above 17mmHg, add Pilo qhs
- If IOP is above 22mmHg, add Pilo BID
- At POW#1, stop antibiotics, use PF 4x/day
- Keep HOB elevation for first 1-2 weeks (or until hyphema gone)
- Have patient sleep on side of surgery (if needed)
  - Blood will pool temporally, not nasally

Post-op Regimen

- Take back to OR for a/c washout at POD7-10 if hyphema still significant
- Keep patient on topical steroids until a/c quiet
- Treat IOP with pilo first then beta-blocker or combined meds if one sees a steroid response
- Once a/c is quiet, taper to PF qday and Pilo qhs for 3-6 months
- If IOP not ideal, consider latanoprost qhs and/or timolol qAM

Conclusions

- GATT procedure:
  - Novel
  - Safe
  - Minimally Invasive
  - Conjunctival sparing
  - Successful
    - 24 months
      - Mean IOP decreased from 26.1mmHg to 14.53 mmHg
      - Mean meds decreased from 3.13 to 1.43

Conclusions

- Suture GATT (5-0 prolene) is equally effective
  - Cost is 4 USD compared to >$750 for catheter
  - Possibly easier to teach technique with catheter
- When discussing MIGS, we need to start discussing cost-effective delivery of care

Cost per mmhg reduction ($ Cad)

*iStent $200
*Xen gel stent $122
*Cypass $148
*Trabectome $142
*GATT $0.81

Notes:

This is ballpark data, as all the trials were somewhat different and this only covers the device cost, not other incidentals

Bryce Ford, MD

GATT Worldwide

- Performed all around the world including:
  - Australia
  - Brazil
  - Bulgaria
  - Canada
  - Chile
  - China
  - Colombia
  - Costa Rica
  - India
  - Iraq
  - Italy
  - Japan
  - Lebanon
  - Mexico
  - Nepal
  - Nigeria
  - Pakistan
  - Peru
  - Romania
  - Saudi Arabia
  - Switzerland
  - Turkey
  - United Kingdom
  - United States
  - And more…..

GATT performed in >24 countries around the world

For those who wish to learn GATT

- For the past 3 years we have taught a course at the AAO
  - Instructional GATT course with international experts
- I have an open door policy in my OR for anyone wishing to learn GATT
- Interesting how procedures are learned and taught without industry support

Thank you for your time

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