
2022

GATT: A Micro-invasive Glaucoma Surgery and a Big Step for Glaucoma Treatment

Mose Im, BS
Thomas Jefferson University

Follow this and additional works at: <https://jdc.jefferson.edu/insight>

 Part of the [Ophthalmology Commons](#)

[Let us know how access to this document benefits you](#)

Recommended Citation

Im, BS, Mose (2022) "GATT: A Micro-invasive Glaucoma Surgery and a Big Step for Glaucoma Treatment," *inSIGHT*: Vol. 2: Iss. 1, Article 6.

Available at: <https://jdc.jefferson.edu/insight/vol2/iss1/6>

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning \(CTL\)](#). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in inSIGHT by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: JeffersonDigitalCommons@jefferson.edu.

GATT: A Micro-invasive Glaucoma Surgery and a Big Step for Glaucoma Treatment

By Moses Im, BS | Faculty Mentor: Lauren Hock, MD & Marlene Moster, MD

Glaucoma is a group of ocular diseases characterized by damage to the optic nerve that may lead to permanent vision loss. Currently, 76 million people (aged 40-80 years) suffer from glaucoma, and the prevalence is projected to increase to 111.8 million by 2040.¹ The diagnosis of glaucoma can be frightening, particularly because there is no known cure. Fortunately, recent advancements in glaucoma surgery have made more options available for patients presenting with new-onset glaucoma. In particular, patients with mild to moderate glaucoma may be eligible for newer minimally invasive glaucoma surgeries (MIGS). This review is both an overview of MIGS, a new class of glaucoma surgeries, and a case study on how one of these novel procedures saved a 47-year-old woman's vision.

Glaucoma is an optic neuropathy characterized by progressive deterioration of the retinal neural ganglion and nerve fiber layer.² The exact mechanism of nerve damage is unknown, but high intraocular pressure (IOP) is commonly correlated. Under normal conditions, IOP is maintained through a constant flux of aqueous fluid from the posterior chamber through the pupil into the anterior chamber of the eye.³ The aqueous humor nourishes the anterior chamber and then leaves via the trabecular meshwork and Schlemm's canal

into the venous drainage system deep within the sclera. In open-angle glaucoma, elevated IOP may be due to progressive microscopic clogging of the trabecular meshwork, the primary source of aqueous outflow (Figure 1).³ Secondary open-angle glaucoma can commonly occur with chronic corticosteroid use, where there is a similar microscopic clogging of the trabecular meshwork. The exact process of aqueous outflow impediment is uncertain, but it is hypothesized that

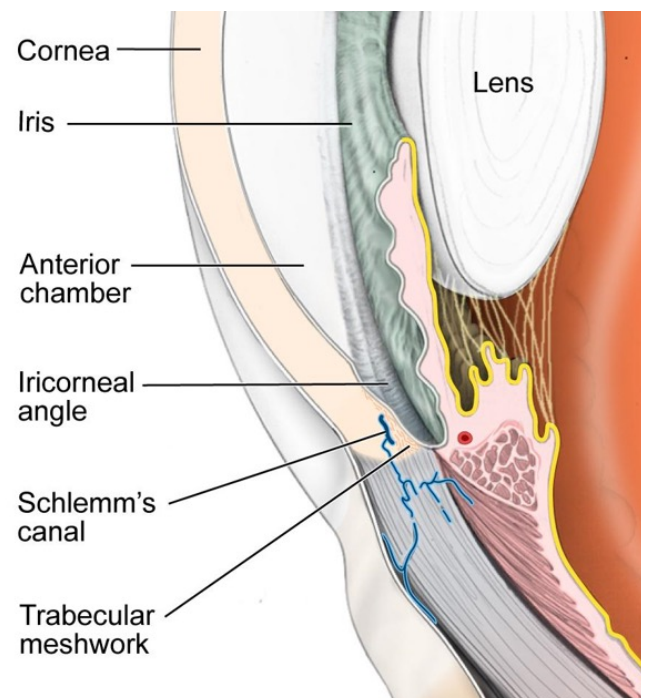


Figure 1. Anatomy of the eye demonstrating the aqueous fluid movement from the anterior chamber into Schlemm's canal through the trabecular meshwork. Blockage of the trabecular meshwork seen in primary open-angle glaucoma. Figure adapted from National Eye Institute, National Institutes of Health Media Library.¹³

glycosaminoglycan accumulation in the trabecular meshwork causes elevated IOP.⁴ Early-onset of glaucoma is typically asymptomatic, but glaucoma progression leads to characteristic visual field loss.

The treatment options for glaucoma include medications, laser, and surgical intervention. Importantly, these treatments help prevent disease progression but do not reverse visual field loss. Therefore, early treatment is critical for the maintenance of vision and maximizing quality of life.⁵

Of the surgical interventions, the most performed traditional procedure is a trabeculectomy. This procedure lowers the IOP by creating an alternative drainage pathway, or a “bleb”, for the aqueous fluid. A small incision is made through the superior limbus, the border between

bleb leaks, and infections like blebitis and endophthalmitis.⁵⁻⁷ Importantly, these complications may result in blindness. While trabeculectomy is often indicated for patients with severe glaucoma, its risks are often considered too great to treat mild to moderate disease. As a result, novel surgery alternatives have been explored in the past decade to treat patients with mild to moderate glaucoma.

In the past few decades, MIGS (Minimally Invasive Glaucoma Surgery) has emerged as a novel class of surgery to reduce IOP with the aim of creating minimal damage to the sclera or conjunctiva, reducing the duration of recovery, and producing more standardized outcomes.⁵ Several forms of MIGS increase aqueous outflow by bypassing the trabecular meshwork,

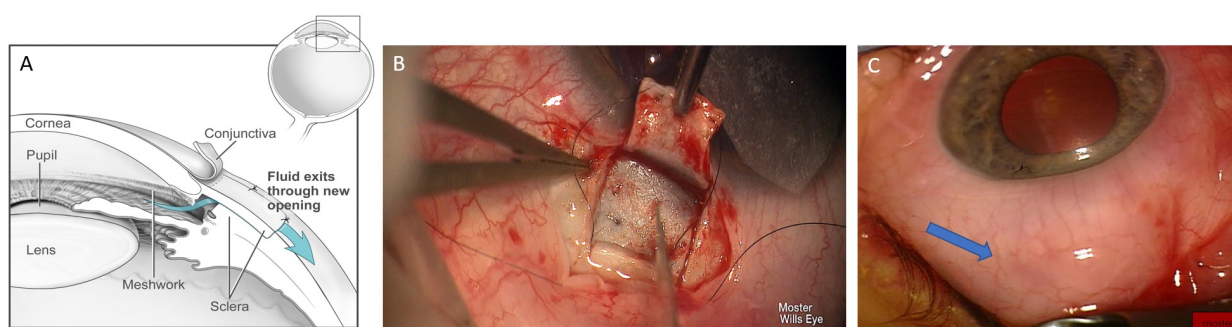


Figure 2. *Intraoperative and Postoperative Images of Trabeculectomy* A) Anatomy of the eye demonstrating the new opening made in trabeculectomy. B) Real image of the incision through the superior limbus. C) The arrow indicates the bleb that forms from the elevation of the conjunctiva. Image A adapted from National Eye Institute, National Institutes of Health Media Library. Images B and C provided by Marlene Moster, MD, Wills Eye Hospital.

the cornea and the sclera, so that excess fluid drains under the conjunctiva (Figure 2). While trabeculectomy is effective, it requires a lengthy 6-week recovery period. Serious risks include hypotony (very low IOP), choroidal effusion, hemorrhage,

whereas other forms reduce fluid production by ablating the ciliary body. A common technique used in MIGS is the “ab interno” approach. In this technique, a corneal or limbal microincision is performed to preserve ocular tissue rather

than the classic scleral incision used in trabeculectomy. The iStent is a MIGS procedure, where a 1mm stent is inserted through the trabecular meshwork into Schlemm's Canal, allowing for increased outflow of aqueous fluid.⁸ The Kahook dual blade is another MIGS device that is inserted into Schlemm's Canal through the trabecular meshwork. The ramp of the blade subsequently excises a strip of the trabecular meshwork, exposing a direct opening to the outer wall of the Schlemm's Canal.⁹ Another MIGS stent is XEN, a gel stent that is inserted from the anterior chamber to the subconjunctival space, creating a small outflow tunnel that functions similarly to the bleb formed with a trabeculectomy.¹⁰ While many studies show that standard glaucoma surgeries reduce IOP to a greater degree than MIGS, MIGS has demonstrated good efficacy in decreasing IOP in select mild to moderate cases while also displaying reduced rates of complications.^{8,9,10}

The gonioscopy-assisted transluminal trabeculotomy (GATT), another MIGS subtype, was first introduced by Grover et al., from Glaucoma Associates of Texas. GATT is a MIGS procedure that involves threading a catheter or suture through Schlemm's canal within the anterior chamber in a 360-degree manner. The distal tip of the catheter or suture is then removed, causing a circumferential tearing of the roof of Schlemm's canal (Figure 3).¹¹ Grover, et. al. described GATT as a safe and effective procedure in 2014. The authors divided 85 patients into primary open-angle glaucoma and secondary glaucoma cohorts. In the primary glaucoma

group, there was a $30\% \pm 22.7\%$ mean reduction in IOP, while in the secondary glaucoma group, there was a $52.7\% \pm 15.8\%$ reduction. The most common complication was transient hyphema, occurring in 30% of patients within 1 week of surgery. Finally, there was a 9% failure rate, where 8 patients required additional glaucoma surgery. The GATT procedure was further analyzed by Rahmatnejad and Moster et al. at Wills Eye Hospital in 2017.¹² In their retrospective chart review of 66 patients, they had a 63% success rate, where surgical success was defined as not needing further glaucoma surgery upon follow-up evaluation. They reported a 44% mean reduction in IOP and a 38% rate of hyphema at postoperative week one, which decreased to 6% at one month. Their results suggested that GATT was effective and had lower rates of serious complications. Furthermore, this operation requires no sutures and preserves conjunctival tissue by avoiding the creation of a bleb, allowing for future glaucoma surgeries if needed. In summary, GATT is a promising procedure with a lower risk of serious complications for the future of glaucoma surgery.

To highlight the promise of MIGS, we will describe the case of a 47-year-old Jefferson Internist whose vision was preserved through the GATT operation. This healthy physician, with no family history of uveitis, glaucoma, or blindness, developed abrupt uveitis in both eyes and an epiretinal membrane in her left eye. She was prescribed topical and oral steroids for months to control the uveitis and developed steroid-induced

glaucoma. After which, she was prescribed oral Diamox (acetazolamide), for maximum IOP control. However, when she presented to Dr. Marlene Moster, her IOP remained elevated (OD 48 mmHg, OS 50 mmHg; normal 10-21 mmHg). Her vision was 20/20 in the right eye and 20/40 in the left eye. On exam, she was noted to have mild bilateral posterior subcapsular cataracts, with more advanced cataracts in the right eye. She had a disc damage likelihood score (DDLS) of 3/10 bilaterally which indicated mild optic nerve damage without visual field loss. The optical coherence tomography (OCT) displayed the preservation of nerve fibers (over 100 microns).

While this patient presented with steroid induced elevated IOP, she did not yet have significant optic nerve damage and as a result, was a good candidate for the

GATT procedure. GATT was performed on her left eye followed by the right eye. Since surgery, the patient demonstrates stable IOPs (11mmHg) and only takes one drop of aqueous suppressant daily. At her 5-year follow-up, the uveitis is controlled, her visual fields and OCT were normal, her optic nerve appearance was unchanged, and her vision was 20/20 bilaterally. This case demonstrates how a busy physician was able to maintain her vision and excellent quality of life. GATT surgery can oftentimes be an effective treatment option for patients with mild to moderate glaucoma, particularly in steroid-induced glaucoma.

In summary, while traditional glaucoma surgeries, such as trabeculectomy, are effective at lowering IOP, the rise of MIGS operations provides safer options for patients meeting certain criteria. Further

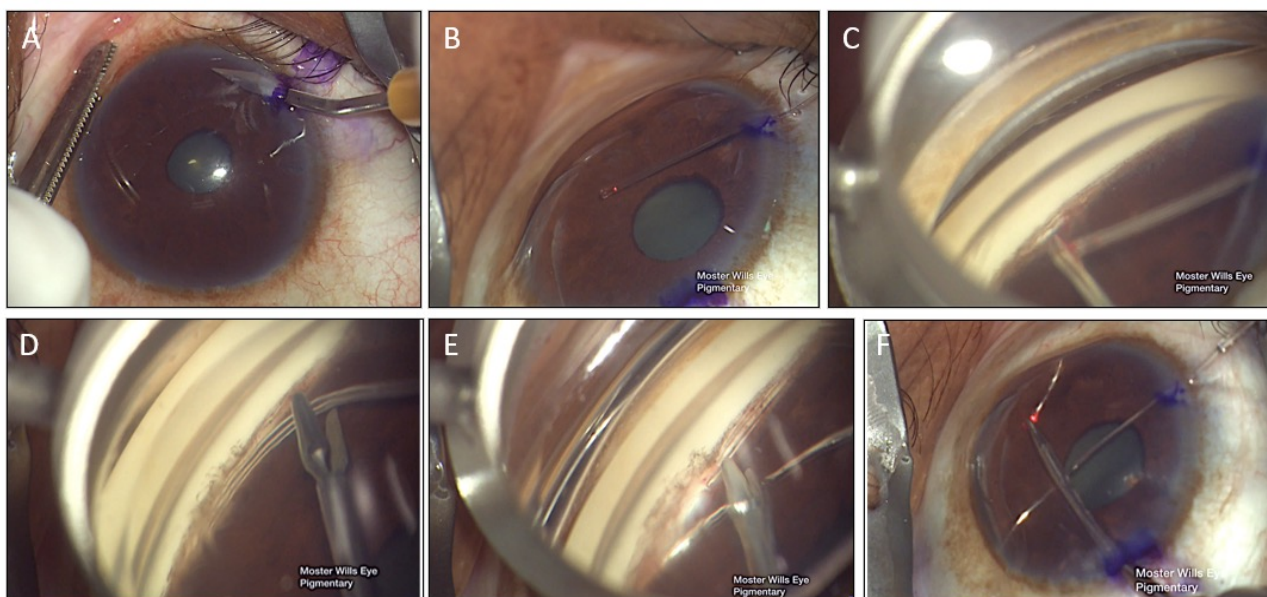


Figure 3. Demonstration of the steps of the GATT procedure. A) Initial corneal incision is made. B) The catheter is inserted into the anterior chamber. C) An incision in the trabecular meshwork is made to gain access to Schlemm's canal. D) The distal tip of the catheter canulates Schlemm's Canal. E) The catheter is passed through the canal in a 360-degree manner. F) The distal tip of the catheter is retrieved and removed to create the circumferential tear of Schlemm's Canal. Images provided by Marlene Moster, MD, Wills Eye Hospital.

research is needed to identify the best candidates for GATT, while also clarifying the long-term efficacy of this operation. Overall, MIGS, particularly GATT, is an exciting and promising development for the field of glaucoma.

References:

1. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. *Ophthalmology*. 2014;121(11):2081-2090. doi:10.1016/j.ophtha.2014.05.013
2. Allison K, Patel D, Alabi O. Epidemiology of Glaucoma: The Past, Present, and Predictions for the Future. *Cureus*. 12(11):e11686. doi:10.7759/cureus.11686
3. Weinreb RN, Aung T, Medeiros FA. The Pathophysiology and Treatment of Glaucoma. *JAMA*. 2014;311(18):1901-1911. doi:10.1001/jama.2014.3192
4. Boese EA, Shah M. Gonioscopy-assisted Transluminal Trabeculotomy (GATT) is An Effective Procedure for Steroid-induced Glaucoma: *Journal of Glaucoma*. 2019;28(9):803-807. doi:10.1097/IJG.0000000000001317
5. Fellman RL, Mattox C, Singh K, et al. American Glaucoma Society Position Paper: Microinvasive Glaucoma Surgery. *Ophthalmology Glaucoma*. 2020;3(1):1-6. doi:10.1016/j.ogla.2019.12.003
6. Fontana H, Nouri-Mahdavi K, Lumba J, Ralli M, Caprioli J. Trabeculectomy with Mitomycin C: Outcomes and Risk Factors for Failure in Phakic Open-Angle Glaucoma. *Ophthalmology*. 2006;113(6):930-936. doi:10.1016/j.ophtha.2006.01.062
7. Wong TT, Khaw PT, Aung T, et al. The Singapore 5-Fluorouracil Trabeculectomy Study: Effects on Intraocular Pressure Control and Disease Progression at 3 Years. *Ophthalmology*. 2009;116(2):175-184. doi:10.1016/j.ophtha.2008.09.049
8. Wellik SR, Dale EA. A review of the iStent® trabecular micro-bypass stent: safety and efficacy. *Clin Ophthalmol*. 2015;9:677-684. doi:10.2147/OPHTH.S57217
9. Dorairaj SK, Seibold LK, Radcliffe NM, et al. 12-Month Outcomes of Goniotomy Performed Using the Kahook Dual Blade Combined with Cataract Surgery in Eyes with Medically Treated Glaucoma. *Adv Ther*. 2018;35(9):1460-1469. doi:10.1007/s12325-018-0755-4
10. Mansouri K, Bravetti GE, Gillmann K, Rao HL, Ch'ng TW, Mermoud A. Two-Year Outcomes of XEN Gel Stent Surgery in Patients with Open-Angle Glaucoma. *Ophthalmol Glaucoma*. 2019;2(5):309-318. doi:10.1016/j.ogla.2019.03.011
11. Grover DS, Godfrey DG, Smith O, Feuer WJ, Montes de Oca I, Fellman RL. Gonioscopy-Assisted Transluminal Trabeculotomy, Ab Interno Trabeculotomy: Technique Report and Preliminary Results. *Ophthalmology*. 2014;121(4):855-861. doi:10.1016/j.ophtha.2013.11.001
12. 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;26(12):1137-1143. doi:10.1097/IJG.0000000000000802
13. National Eye Institute. NEI-medialibrary-2863348.jpg. National Eye Institute Media Library. https://medialibrary.nei.nih.gov/search?keywords=glaucoma&items_per_page=20&page=1#/media/3714. Published May 12, 2020. Accessed January 18, 2022.
14. National Eye Institute. NEI-medialibrary-3729535.jpg. National Eye Institute Media Library. https://medialibrary.nei.nih.gov/search?keywords=glaucoma&items_per_page=20&page=1#/media/3717. Published May 12, 2020. Accessed January 18, 2022.