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Considerations for Adding Minimally/Microinvasive Glaucoma Surgery (MIGS) to a Planned Cataract Surgery

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Introduction

Glaucoma is a progressive optic neuropathy defined by retinal ganglion cells loss and characteristic visual field loss. It is a leading cause of irreversible blindness and affects over 60 million people worldwide.[1] Its prevalence is estimated to increase to 111.8 million by 2040.[1] Intraocular pressure (IOP) is a major clinically modifiable risk factor for glaucoma. Thus, glaucoma therapy aims to reduce the IOP using medications, lasers (e.g., selective laser trabeculoplasty) or surgery. Historically, surgery has been reserved for advanced glaucoma and in cases with poorly controlled pressure despite medical and laser treatment. For decades, trabeculectomy and tube shunt devices have been the predominant surgical methods for lowering ocular pressure.[2] However, these traditional surgeries are invasive requiring significant manipulation of ocular tissue and have significant post-operative complication rates.[3] Many patients have fallen in the gap of needing more pressure lowering but not enough to justify a higher risk surgery. Fortunately, the landscape of glaucoma surgery has rapidly evolved over the past 20 years with the emergence of minimally/micro-invasive glaucoma surgery (MIGS).

MIGS is often performed as an adjunct to cataract surgery. As such, there is minimal added long-term risk if the procedure is done in the same space as the already planned cataract surgery. This represents a large group of patients, some of whom would not have been considered as glaucoma surgical candidates in the past. The clinician is now faced with the question, "Should I add MIGS to the cataract surgery?" In this paper, we suggest a series of questions to ask about each case in order to help make a patient-centred decision.

Minimally/Microinvasive Glaucoma Surgery (MIGS)

MIGS is defined as any device or a procedure with the following characteristics[4]: **1)** Good safety profile compared to traditional surgeries (e.g., fewer complications of hypotony, choroidal hemorrhage, or choroidal effusion); **2)** Less invasive with minimal trauma to ocular tissue; **3)** Typically performed as an internal approach through a small corneal incision (also called ab interno approach); **4)** Shorter operating time; **5)** Quicker post-operative recovery period and; **6)** Moderate IOP lowering effects (at least a 20% IOP reduction).

MIGS is typically indicated for patients with mild-to-moderate open angle glaucoma (OAG) who have failed IOP control despite medical management or laser treatment. In addition, it can be considered in patients with medication noncompliance, intolerance due to side effects, or a desire to decrease the number of medications used. It has also shown utility in secondary glaucoma (e.g., pseudoexfoliation or pigment dispersion glaucoma).[5,6]

MIGS is classified into five broad categories based on the anatomical target site (**Figure 1**)[2]: **1)** Trabecular meshwork bypass, in which aqueous humor is provided direct access to the Schlemm's canal using a stent or excising the trabecular meshwork tissue; **2)** Canaloplasty, where Schlemm's canal and collector channels are dilated to enhance outflow; **3)** Enhancing outflow through the uveoscleral pathway by placing a bypass device into the suprachoroidal space; **4)** Schlemm's canal bypass, where a filtering device directs outflow to the subconjunctival/sub-tenon space and forms

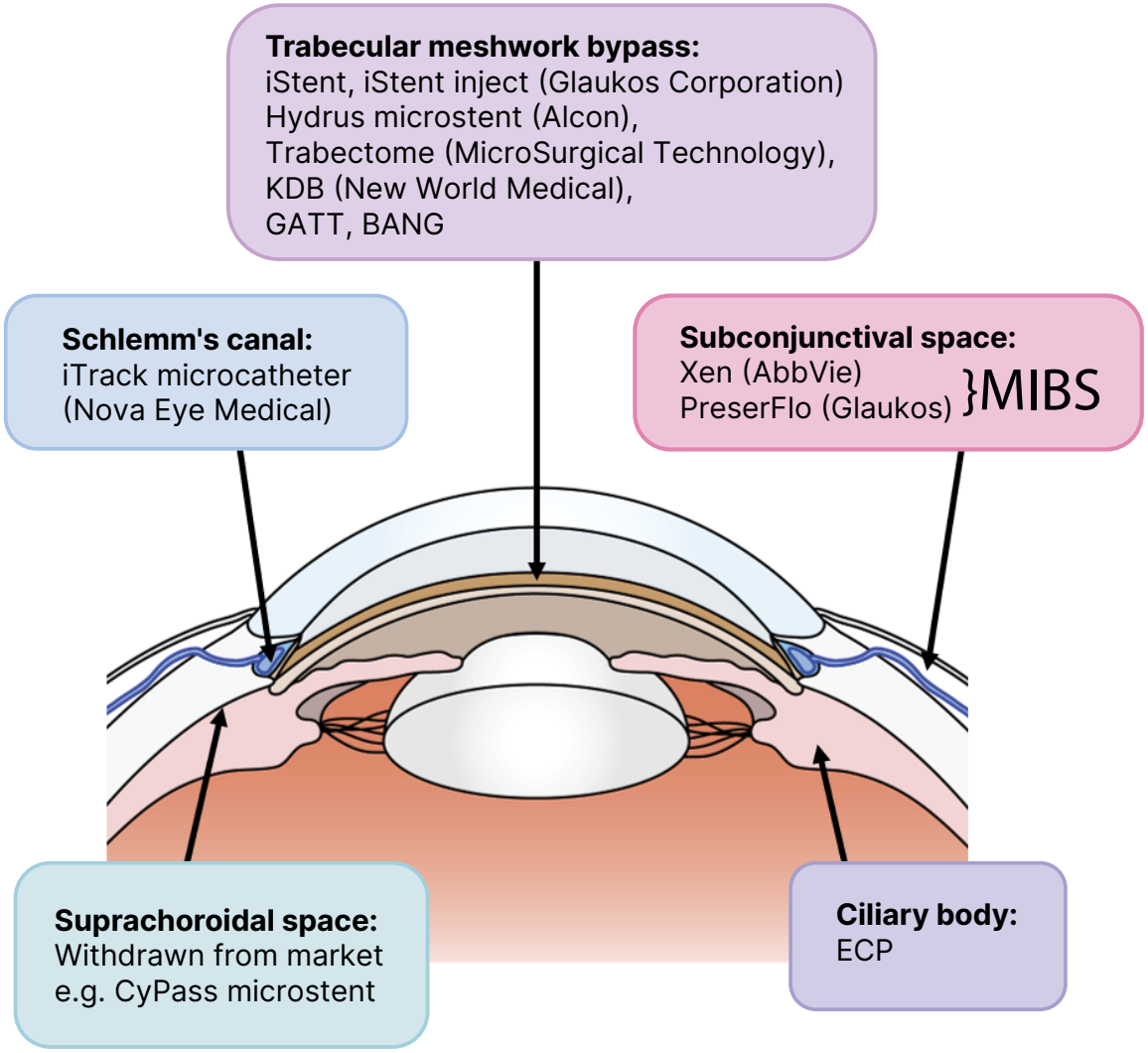

Figure 1. MIGS classification by anatomy; *courtesy of Pushpinder Kanda, MD, PhD and Garfield Miller, MD*.

Abbreviations: BANG: Bent ab interno needle goniectomy, **ECP:** Endoscopic cyclophotocoagulation, **GATT:** Gonioscopy-assisted transluminal trabeculotomy, **KDB:** Kahook dual blade, **MIBS:** minimally invasive bleb surgery

a bleb; **5)** Decreasing aqueous production by causing destruction of ciliary body epithelium.

Some authors highlight that the newer Schlemm's canal bypass surgeries (e.g., XEN gel stent or PreserFlo microshunt) do not strictly meet the criteria of MIGS due to the formation of a filtering bleb. Instead, the term minimally invasive bleb surgery (MIBS) has been adopted because it is less invasive and safer than traditional filtering surgery. Unlike MIGS, MIBS is more often used to treat moderate-to-advanced glaucoma as it can achieve low-teen to single-digit pressure. MIBS and suprachoroidal microstents are not covered in this review; however, coverage of them can be found elsewhere in detail.[2,7] Currently, there are no suprachoroidal microstents available in the North American market outside of investigational use. Last, endoscopic cyclophotocoagulation (ECP) may not always be categorized as conventional MIGS due to increased risk of complications such as inflammation and cystoid macular edema.[8,9]

Combined Cataract and MIGS Surgery (cMIGS)

MIGS can be performed alone or in combination with cataract surgery (cMIGS) for OAG.[10] Several studies have shown that cMIGS can improve IOP control and decrease the burden of glaucoma medications when compared to standalone surgery.[10-13] For example, the two-year pivotal iStent trial showed a 20% reduction in diurnal IOP from baseline in greater number of eyes treated with combined iStent in cataract surgery vs cataract surgery alone (75.8% of eyes for the combined group vs 61.9% for cataract surgery only, P=0.005).[14] Among the IOP responders, 84% of eyes with combined treatment and 67% with cataract surgery alone did not require glaucoma medication at 23 months. **Table 1** summarizes the results of various studies combining MIGS with cataract surgery for open angle or secondary glaucoma.

While lowering IOP and decreasing medication are desirable outcomes, ultimately preservation of vision is most important. Studies have shown that cMIGS can help decrease the need for incisional glaucoma filtering surgeries.[13] For example, the HORIZON trial showed that Hydrus® microstent combined with cataract surgery had less risk for needing major incisional glaucoma surgery at 5 years compared to cataract surgery alone (2.4% risk for combined surgery vs 6.2% for cataract alone, P=0.027).[13] In addition, this was one of the first studies to show that combined surgery resulted in slower progression of visual field loss (progression rate of -0.26dB/year [95% CI: -0.36 to -0.16] for the combined group vs to -0.49 dB/year [95% CI: -0.63 to -0.34] for cataract surgery alone, P=0.0138).[15]

An important consideration for most cMIGS is that studies have not shown an increase in serious complication rate compared to cataract surgery alone.[12,16] This makes cMIGS an attractive option for many glaucoma patients already being considered for cataract surgery.

Questions to Ask of Each Case

Is the glaucoma controlled?

Glaucoma is typically a chronic, slowly progressive disease. In the past, absolute IOP values were relied upon to decide if glaucoma was adequately treated. We now know that there is no universal pressure at which glaucoma can be considered controlled. Setting targets, then monitoring over time, typically with perimetry and structural analysis, is required to ensure stability.

In cataract cases where the glaucoma is early and controlled, cMIGS may not be required. In the early post-operative period following cataract surgery, IOPs can be variable with higher incidence of spikes in glaucoma patients.[30] Following the post-operative period, however, IOP generally tends to decrease slightly in OAG.[12,31] Craven RE *et al.* showed that patients with mild-to-moderate controlled OAG who underwent cataract surgery had little change in the visual fields despite the small increase in IOP after 2 years.[16] Thus, stable glaucoma patients who can tolerate some early lability in IOP, may opt for cataract surgery alone.

If glaucoma is uncontrolled, even in early glaucoma, MIGS should be considered in patients requiring cataract surgery. Iancu R *et al.* showed that cataract surgery alone decreased the IOP by 1.9±3.9 mmHg at 12 months in patients with uncontrolled primary open-angle glaucoma (POAG); however, 84.2% eventually needed glaucoma surgery by 11.6±4.18 months.[32]

The target IOP and the anticipated degree of IOP reduction are important factors to consider when choosing cMIGS. In cases where the cMIGS will likely place the patient within the target range, it is an excellent option, while minimizing risk. In cases where cMIGS is not possible or unlikely to be adequate for reaching target pressure, MIBS or traditional filtering surgeries should be considered.

Is the current treatment sustainable?

Even if glaucoma is controlled, the surgeon should consider whether or not the current therapy is sustainable. Adherence to medical therapy in glaucoma is notoriously poor with some studies reporting up to 30% non-adherence.[33] Barriers to adherence include cost, use of multiple drops, forgetfulness, psychiatric disorders (e.g,. depression), ocular side effects, and difficulty administering drops.[33] Medical or other life crises can result in prolonged periods with inconsistent medication use. Thus, reducing medication dependency with cMIGS may improve quality of life.[34]

It is important to consider that poor medication adherence leads to greater IOP fluctuations. Large diurnal fluctuation of IOP is an independent risk factor for glaucoma progression.[35] Therefore, these patients would benefit from cMIGS which has shown to provide more stable IOP reduction.[36]

Author (Year of Publication)	Type of Study	Type of Glaucoma	Type of Intervention	Main Outcomes
Samuelson TW *et al.* (2011)[12]	Prospective randomized controlled trial	Mild-to-moderate OAG with IOP ≤24 mmHg controlled on 1 to 3 medications	Treated group= iStent + cataract (n=111 eyes) Control group= cataract surgery alone (n=122 eyes)	• At 1 year, 72% of treated eyes achieved unmedicated IOP ≤21 mmHg vs 50% of control eyes (P<0.001) • 66% of treated eyes achieved 20% IOP reduction without medications vs 48% of control eyes (P<0.003) • Decrease in glaucoma medication was greater in treated group vs control (1.4±0.8 vs 1.0±0.8; P<0.005)
Craven RE *et al.* (2012)[16]	Prospective randomized controlled trial	Mild-to-moderate OAG with unmedicated IOP of ≥22 mmHg and ≤36 mmHg	Treated group= iStent + cataract (n=117 eyes) Control group= cataract surgery alone (n=123 eyes)	• At 2 years, 61% of treated eyes achieved unmedicated IOP ≤21 mmHg vs 50% of control eyes (P<0.036) • Trend in favour of treated group for achieving 20% IOP reduction without medications vs 44% of control eyes (53% treated vs 44% control eyes, P<0.09)
Wang SY *et al.* (2019)[6]	Retrospective, observational longitudinal cohort study	POAG (78.4%), Narrow angles (12.8%), Secondary OAG which included pigmentary glaucoma and PXG (8.8%)	Treated group= iStent + Cataract surgery (n=2971 subjects) Control group= Cataract surgery alone (n=1486 subjects)	• Treated group had a greater reduction in glaucoma drops (0.99 in treated vs 0.49 in control at month 20–24; P < 0.001) • Treated group had higher proportion receiving no glaucoma drops after surgery (73.5% in treated vs 55.3% in control at month 20-24; P <0.001)
Hengerer FH. *et al.* (2022)[17]	Prospective, longitudinal case series	POAG (74%), PXG (19%), Combined mechanism (5%), Pigmentary glaucoma (1%), NVG (1%)	iStent inject alone (n=44) iStent inject + cataract surgery (n=81)	• At 5 years, combined surgery reduced the mean IOP by 39% (22.6 to 13.8 mmHg, P<0.001) and medications by 69% (2.52 to 0.78, P<0.001) • Standalone surgery reduced the mean IOP by 42% (25.3 to 14.6 mmHg, P<0.001) and medications by 75% (2.98 to 0.74, P<0.001) • 83% of in the overall cohort achieved ≥20% IOP reduction

Author (Year of Publication)	Type of Study	Type of Glaucoma	Type of Intervention	Main Outcomes
Samuelson TW. *et al.* (2019)[14]	Prospective, randomized controlled trial	Mild-to-moderate POAG with IOP ≤24 mmHg on 1 to 3 medication, unmedicated diurnal IOP 21–36 mmHg	Treated group= iStent inject + cataract surgery (n=387 eyes) Control= Cataract surgery alone (n=118 eyes)	• At 24 months, the treated group had greater proportion of eyes which had ≥20% reduction in unmedicated diurnal IOP from baseline compared to control group (75.8% treated vs 61.9% control, P=0.005) • The mean reduction in unmedicated diurnal IOP from baseline was greater in treated eyes (7.0±4.0 mmHg treated vs 5.4±3.7 mmHg control; P<0.001)
Ahmed IIK *et al.* (2022)[13]	Prospective, randomized controlled trial	Mild-to-moderate POAG with washed-out diurnal IOP of 22–34 mmHg	Treated group= Hydrus microstent + cataract surgery (n=369 eyes) Control= Cataract surgery alone (n=187 eyes)	• At 5 years, the treated group had higher proportion of eyes with IOP ≤18 mmHg without medications (49.5% treated vs 33.8% control, P=0.003) • Greater proportion of treated eyes had ≥20% IOP reduction (54.2% treated vs 32.8% control, P<0.001) • Greater reduction in medications in treated group (0.5±0.9 treated vs 0.9±0.9 control, P<0.001) • Greater proportion of treated eyes were drop free (66% treated vs 46% control, p<0.001) • Cumulative risk of needing incisional glaucoma surgery was lower in treated group (2.4% treated vs 6.2% control, P=0.027)
Esfandiari H. *et al.* (2019)[5]	Retrospective case series	POAG (62.3%), PXG (14.8%), Pigmentary glaucoma (6.6%), PACG (8.2%), Others secondary cause (8.2%) Glaucoma was mild (34.4%), moderate (26.3%) and severe (39.3%)	Trabectome + cataract surgery (n=61 eyes)	• Success was defined as IOP >5mmHg and ≤ 21 mmHg, ≥ 20% IOP reduction from baseline at two consecutive visits, no need for further glaucoma surgery, and no loss of light perception. • At 5 years, the cumulative success was 67.5%. • IOP decreased from 20±5.6 mmHg at baseline to 15.6±4.6 mmHg (P=0.001) • Trend toward decreasing glaucoma medication compared to baseline (1.8±1.2 at baseline and 1.0±1.2 at 5 years) • Risk factors for failure were lower baseline IOP, younger age, and higher central corneal thickness • Exfoliative glaucoma was associated with higher success rate.

Author (Year of Publication)	Type of Study	Type of Glaucoma	Type of Intervention	Main Outcomes
Tojo N. *et al.* (2020)[18]	Observational, retrospective study	Subjects with low (<18 mmHg), moderate (18–26 mmHg) or high (>26 mmHg) IOP glaucoma Glaucoma included POAG, PXG, PACG, other secondary glaucoma	A total of 204 eyes had trabectome surgery of which n=105 had simultaneous trabectome + cataract surgery	• At 2 years, trabectome surgeries decreased IOP from baseline (23.0±7.2 mmHg baseline to 13.6±3.6 mmHg at 2 years, and 13.2±4.0 mmHg at 5 years) • Thin central corneal thickness and simultaneous cataract surgery were associated with better surgical outcomes with cutoff IOP ≤21 mmHg and ≤15 mmHg
Kuerten D. *et al.* (2023)[19]	Prospective case series	POAG, NTG	KDB + cataract surgery (n= 55 eyes with POAG and n= 14 eyes with NTG)	• At 12 months, IOP was lowered from 19.7±4.7 mmHg at baseline to 16.1±3.2 (P<0.05) in POAG • At 12 months, there was a trend towards reduction of IOP in NTG group (15.1±2.5 mmHg baseline to 13.6±1.8 mmHg, P>0.08) • 64% of all subjects achieved IOP <21 mmHg without need for glaucoma drops
Dorairaj SK. *et al.* (2018)[20]	Prospective case series	POAG (84.6%), Pigmentary glaucoma (7.7%), NTG (3.9%)	KDB + cataract surgery (n= 52 eyes)	• At 12 months, the mean IOP was reduced from 16.8±0.6 mmHg at to 12.4±0.3 mmHg (P<0.001) • A 50% reduction of glaucoma medication was achieved after surgery (1.6±0.2 baseline vs 0.8±0.1 at 12 months, P<0.05) • ≥57.7% of eyes had ≥20% IOP reduction form baseline
Ventura-Abreu N. *et al.* (2021)[21]	Randomized controlled trial	Mild-to-moderate OAG, OHT	Treatment= KDB + cataract (n= 21 eyes) Control= cataract surgery alone (n= 21 eyes)	• At 12-months, there was no significant difference in the reduction of IOP and glaucoma medications between groups. • Both groups showed similar safety profile
DeVience E. *et al.* (2024)[22]	Retrospective case control series	POAG, OHT	Treatment = needle goniotomy + cataract surgery (n=46 eyes) Control= cataract surgery alone (n=115 eyes)	• At 6 months, treated group showed a 28% reduction of IOP (-6.3±6.5 mmHg) compared to 1% IOP reduction (-0.3±2.9 mmHg) for control group (P<0.05). • 23.1% of control group showed an incidence of early IOP spike vs 6.0% of treated group (Odds Ratio=4.5, P<0.05)

Author (Year of Publication)	Type of Study	Type of Glaucoma	Type of Intervention	Main Outcomes
Eslami Y. *et al.* (2022)[23]	Case series	POAG, PXG, OHT	Needle goniotomy + cataract surgery (n=32 eyes)	• At 6 months, there was a 32.1% IOP reduction (21.8±4.6 mmHg at baseline to 14.8±3.9 mmHg after treatment, P<0.001) • There was a 50.0% reduction in medications (1.2±1.5 at baseline to 0.6±1.1 after treatment, P<0.048)
Wan Y. *et al.* (2022)[24]	Consecutive case series	POAG	Microcatheter-assisted GATT only (n=66 eyes) GATT + cataract surgery (n=58 eyes)	• At 24 months, IOP was reduced from 26.40±6.37 mmHg at baseline to 16.08±2.38 mmHg with combined surgery. • Medication was reduced from 3.12±0.80 to 0.45±0.96 with combined surgery • There was no significant difference between combined surgery and GATT only group for IOP and medication reduction. • The incidence of hyphema did not differ between the two groups • Combined surgery had less post-operative IOP spikes (17.2% eyes) vs GATT only group (54.5% eyes), P<0.0001) at 24 months
Williamson BK. *et al.* (2023)[25]	Retrospective, stratified observational study	Mild-to-moderate POAG, PXG, Pigment dispersion glaucoma	Both Group 1 (>18mmgHg) and Group 2 (≤ 18mmHg) had subjects which underwent: Canaloplasty/ trabeculotomy (Omni system) + cataract surgery Canaloplasty/ trabeculotomy (Omni system) surgery alone	• At 2 years, both combined surgery and standalone surgery decreased the IOP and reduced the medication from baseline. • 75% of all subjects had ≥20% IOP reduction, or between 6-18 mmHg, and nor increase in secondary surgical intervention
Greenwood MD. *et al.* (2023)[26]	Prospective, single-arm, intervention study	Mild-to-moderate OAG with IOP ≤33 mmHg, on 1 to 4 medications, and unmedicated post-washout diurnal IOP ≥21 mmHg and ≤36 mmHg POAG (96%), PXG (4%)	Canaloplasty/ trabeculotomy (OMNI system) + cataract surgery (n= 66 subjects)	• At 36 months, subjects experienced a mean reduction of IOP by 6.9±3.4 mmHg (P<0.00001 vs baseline) • 78% of eyes had ≥20% IOP reduction. • Treatment reduced glaucoma medications from 1.7 at baseline to 0.3 at 36 months (P<0.00001 vs baseline). • About 74% of subjects were medication free at 36 months

Author (Year of Publication)	Type of Study	Type of Glaucoma	Type of Intervention	Main Outcomes
Gallardo MJ. *et al.* (2018)[27]	Retrospective, comparative case series	POAG which was mild (37.3%), moderate (16.0%) or, severe (38.7%)	ABiC alone (iTrack surgical system) (n=41 eyes) ABiC + cataract surgery (n=34 eyes)	• At 12 months, combined treatment reduced IOP from 19.4±3.7 mmHg at baseline to 13.0±1.8 mmHg (P<0.001) and medications from 2.6±1.0 at baseline to 0.8±0.2 (P<0.001). • At 12 months, standalone treatment reduced IOP from 21.2±5.3 mmHg at baseline to 13.7±1.9 mmHg (P=0.001) and medications from 3.0±0.7 at baseline to 1.3±1.1 (P<0.001). • 40% of eyes were medication free
Koerber N. *et al.* (2024)[28]	Retrospective consecutive case series	POAG, PXG	ABiC (iTrack surgical system) alone (n=4 eyes) ABiC + cataract surgery (n=23 eyes)	• At 6 years, ABiC (standalone or combined surgery) reduced IOP from 19.9±5.2 mmHg at baseline to 14.6±3.3 (P<0.001) and medications from 1.9±1 at baseline to 0.9±0.9 (P=0.005) • There was statistical different between standalone or combined group and between different types of glaucoma.
Yap TE. *et al.* (2022)[9]	Retrospective case series	POAG	ECP + cataract surgery (n=83 eyes)	• At 3 years, surgery reduced IOP (18.4±5.2 at baseline to 13.6±3.7 mmHg, P<-0.0001) and medications (2.7±0.9 at baseline to 1.8±1.3, P<0.0001). • At 3 years, 45% of patients did not achieve failure (defined as one or more of **(1)** IOP >21 mmHg or <20% reduction from baseline at two consecutive visits, **(2)** IOP < 5 mmHg at any visit or, **(3)** needing further IOP lowering surgery)
Smith M. *et al.* (2018)[29]	Retrospective case series	Uncontrolled glaucoma POAG/NTG (85%), PXG (8%), PACG (7%)	ECP + cataract surgery (n= 84 eyes)	• At 3 years, surgery reduced IOP (18.7 at baseline to 14.0 mmHg). • The number of medications pre- and post-surgery was similar. • The failure rate at 3 years was 58.3% (defined as 1 of 2 criteria **(1)** IOP >21 or <6 mmHg, or not reduced by 20% from baseline, **(2)** further need for laser or surgery at any timepoint

Table 1. Summary of studies combining MIGS with cataract surgery; *courtesy of Pushpinder Kanda, MD, PhD and Garfield Miller, MD.*

Abbreviations: ABiC: Ab interno canaloplasty, **ECP:** Endoscopic cyclophotocoagulation, **GATT:** Gonioscopy-assisted transluminal trabeculotomy, **KDB:** Kahook dual blade, **NTG:** Normal tension glaucoma, **OAG:** Open angle glaucoma, **OHT:** Ocular hypertension, **IOP:** Intraocular pressure, **PACG:** Primary angle closure glaucoma, **POAG:** Primary open angle glaucoma, **PXG:** Pseudoexfoliation glaucoma

Chronic ocular surface inflammation, allergic reactions and systemic side effects can all impact the long-term viability of topical glaucoma treatment. Studies have shown that preservatives in most topical therapies can lead to morbidity due to dry eye and increase the risk of failure for any future filtering glaucoma surgeries.[37,38] Medications such as brimonidine have shown high rates of allergic reaction even years after uneventful use.[39] Overall, decreasing glaucoma medication will benefit patients who might require traditional filtering surgery or MIBS in the future.

Last, progression of glaucoma is associated with both increased treatment cost and worsening quality of life. Thus, decreasing the pharmacotherapy with MIGS can not only improve quality of life but also lead to cost-saving. A cost-effective analysis by Sood S *et al.* showed that iStent and Hydrus microstent combined with cataract surgery were more cost effective and accumulated higher quality-adjusted life year compared to cataract surgery alone.[40]

Overall, cMIGS represents an opportunity to decrease topical drops in stable patients already planning cataract surgery.

Is the angle open or closed?

Multiple studies have shown that standalone cataracts can lower IOP in patients with OAG, leading some to question whether or not cMIGS is necessary at all.[12,16] Although IOP reduction has been shown with cataract surgery alone, visual field stabilization has not been demonstrated in OAG.[41] One study using the Corvis ST tonometer showed that the cornea biomechanics change following cataract surgery.[42] It was suggested that a component of the measured IOP lowering seen postoperatively may be due to biomechanical changes as opposed to a true lowering of IOP. Ultimately, the goal of glaucoma treatment is preventing progression and cMIGS has been shown not only to lower pressure, but also help in the stabilization of the disease.[15]

In contrast, cataract surgery alone in angle closure glaucoma (ACG) has demonstrated both IOP reduction and visual field stabilization.[41] In cases where there is peripheral anterior synechiae (PAS) and ACG, goniosynechialysis can result in additional lowering of pressure.[43] However, the likelihood of significant IOP lowering may decrease with the chronicity of PAS.[44] Furthermore, patients with chronic ACG may also have underlying trabecular meshwork (TM) dysfunction.[45] In these cases, removal of anatomical closure with cataract surgery alone may only provide partial benefit since TM-dysfunction still needs to be addressed. In these cases, cMIGS has shown to benefit patients.[45] Various studies have shown cMIGS can significantly decrease IOP in ACG.[46,47] For example, a case series by Hernstadt DJ *et al.* showed that combined iStent with cataract surgery in primary angle closure or primary angle closure glaucoma (PACG) was effective in lowering IOP and reducing the number of glaucoma medications in 89.2% of the eyes at 1 year.[46]

In addition, narrow angles are not synonymous with angle closure. For example, a 2018 study by Xu BY *et al.* used anterior segment OCT to demonstrate that only patients with angle narrowing below a certain anatomical threshold had an association with increased IOP.[48] Similarly, Porporato N *et al.* showed that only patients with iridocorneal touch greater than ~60% seen on anterior segment OCT or an anterior chamber depth of less than 2.5 mm were associated with increased IOP.[49] Considering these findings, we should be cautious about attributing glaucoma or an elevated IOP solely to clinically narrow angles determined by gonioscopy. It may be prudent to consider cMIGS in scenarios where angles just meet the gonioscopic criteria for "narrow" or where secondary causes such as pseudoexfoliation are identified.

Some cases of primary angle closure have a significant component of plateau iris. At times, angles may remain very narrow or closed following cataract surgery.[50] ECP is MIGS procedure with a specific application in these difficult cases. Often referred to as endocycloplasty when used to treat plateau iris, it can be combined with cataract surgery to significantly open the angle.[51] This involves the application of a diode laser via endoscope to the anterior ciliary processes in the sulcus. The endpoint is the shrinkage and retraction of the ciliary processes, directly treating the mechanism of angle closure.

What is the stage of glaucoma?

While pivotal trials generally indicated MIGS for mild-to-moderate glaucoma, some studies have shown that it may be an option for some moderate-to-advance cases.[52-54] One study compared multi-iStent to trabeculectomy in patients with moderate-to-severe glaucoma and showed that both procedures reduced IOP, but the reduction was less pronounced in the multi-stent group (mean post-operative IOP of 14.2 mmHg or 31% reduction in multi-stent group and 12.5 mmHg

or 43% reduction in trabeculectomy group).[52] Patients with multi-stent required one additional medication compared to the trabeculectomy group, but still had a 51% reduction compared to baseline. However, patients with multi-stent benefited from a more favourable safety profile and improved quality of life. Similarly, the Hydrus microstent has also shown to reduce IOP and medications in advanced glaucoma but its effects were less marked compared to those in milder glaucoma.[54] Gonioscopy-assisted transluminal trabeculotomy (GATT) combined with cataract surgery has also shown to be effective for at least 76.67% of advanced POAG cases.[24] Overall, MIGS can occasionally be an option for advanced glaucoma patients, especially if they are not good candidates for bleb-forming filtering surgeries. However, closer follow-up is mandated to ensure adequate glaucoma control and monitoring for post-operative pressure spike secondary to hyphemia, steroid response or long-term IOP elevation due to PAS.[24,25] If MIGS does not lower IOP as expected, the surgeon must have options available for more traditional surgeries soon after. In addition, longevity of effect needs to be considered carefully as long-term studies for MIGS are still limited.

Is it a refractive cataract surgery case?

Glaucoma patients are shown to have a higher incidence of refractive surprise following cataract surgery.[55] Nonetheless, they should be offered the opportunity to obtain the best refractive outcomes that they can safely achieve, paying special attention to contrast sensitivity and potential for future disease progression. Optimization of refractive outcomes through advances in diagnostics, planning software, lens options, and femtosecond laser are increasingly being offered to glaucoma patients. Numerous publications reviewing various cMIGS have demonstrated no significant effect on refractive outcome by the MIGS component.[56,57]

There are a few specific considerations in refractive cases. Post-operative visual recovery can be prolonged in many cMIGS with hyphema being one of the main transient complications. A thorough pre-operative consent process should include a discussion about these complications in order to set appropriate expectations.

Femtosecond laser can be a helpful adjunct in some refractive cataract surgery cases, but may pose some risk in certain cMIGS. Chang E. *et al.* published a case report in 2021 highlighting the risk of intractable hyphema with trabecular meshwork ablation following femtosecond laser.[58] Increased episcleral venous pressure from the docking and vacuum process was believed to be the cause. iStent following femtosecond laser has been reviewed in the literature and does not appear to have a significant hyphema risk.[57,59]

ECP has been shown to affect refractive outcomes. Wang JC *et al.* showed that patients with ACG undergoing cataract surgery combined with ECP had decreased predictability of postoperative refractive error.[60] Overall, there is a tendency toward a small myopic surprise.

Conclusion

MIGS has changed the landscape of glaucoma management. When glaucoma patients already require cataract surgery, it is an opportune time to consider adding MIGS. The risk/benefit ratio is improved as most MIGS's have not been shown to increase the risk of serious complication further than the cataract surgery itself. In the decision-making process, one should consider the degree of stability/control, the sustainability of the current treatment, whether the angle is open or closed, the stage of the glaucoma, and whether refractive cataract surgery options are being considered. Cost and local availability of MIGS options are additional factors beyond the scope of this paper. Considering the mounting evidence of its safety and benefits, cMIGS is an important component of the discussion with glaucoma patients requiring cataract surgery.

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