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MD, FRCSEd, FRCOpth
Chairman Scientific Committee
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Scientific Committee

Step by Step Ophthalmic Surgery Training Module

MINIMALLY INVASIVE GLAUCOMA SURGERY

All India Ophthalmological Society
Scientific Committee

MINIMALLY INVASIVE GLAUCOMA SURGERY

Step by Step Ophthalmic Surgery Training Module

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Foreword

Dr. Prof. Namrata Sharma
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The field of glaucoma surgery has seen rapid advancements over the last decade with several new innovations in laser techniques and minimally invasive glaucoma surgery (MIGS). These procedures require special training and expertise which is not easily available across the globe. There is an unmet need for step by step surgical training in intraoperative gonioscopy, various MIGS techniques, new laser therapies and management of complications associated with these procedures. As Chairman of the Scientific Committee of the All India Ophthalmological Society, I am pleased to present to you this valuable addition to our "Step by Step Ophthalmic Surgery" learning series. This is a unique video assisted skill transfer module which gives a comprehensive knowledge about current MIGS techniques with help of intra-operative surgical videos. This is a compilation of the top global experts in glaucoma surgery and surgeons from India who have pioneered the use of MIGS in our country. The module includes QR codes for each presentation so that there is easy access to the surgical videos at any time especially if any intraoperative guidance is required. I wish to thank Prof. Tanuj Dada for putting together this wonderful educational feast for the ophthalmic community and also express my gratitude towards all the National and international experts who have contributed to this outstanding module.

I am sure that this training module will herald a new era in ophthalmic education in the Asia-Pacific region and improve the standard of surgical care for glaucoma patients worldwide.

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Editorial

Tanuj Dada

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Minimally invasive glaucoma surgery (MIGS) done in conjunction with cataract surgery has become the standard of care for early to moderate glaucoma. There are two major categories of MIGS which are currently popular : 1) Angle based MIGS procedures – cutting/stenting/dilating the canal of Schlemm which are ideally suited for ocular hypertension and early glaucoma and 2) Minimally invasive bleb surgery which involve implants like the Preserflo / Xen implant or use devices which create a micro-sclerostomy and are suitable for moderate to advanced glaucoma. Supraciliary implants like the MINIject are also being performed as MIGS procedures but have not gained widespread acceptance especially since the recall of CyPass micro-stent due to corneal endothelial damage issues in 2018. Although there are several exciting laser/device based MIGS procedures in the pipeline, no MIGS technique has yet emerged as the "gold standard" for any stage of glaucoma and current practice patterns for MIGS are largely based on individual surgeon training / preferences and are often biased by industry sponsorship. I would like to share the following insights that I have learnt and "still learning" about MIGS :

Intraoperative gonioscopy has become an essential skill which must be mastered before performing angle based MIGS procedures. Identification of the pigmented trabecular meshwork (TM) and operating on it through the gonioscope is a critical skill as inadvertent pressure / incision on wrong structure can lead to serious complications such as cyclodialysis.

As per the recent report by American Academy of Ophthalmology, the major IOP drop in combined phaco-MIGS procedures is attributed to cataract surgery. They reviewed 10, level 1 randomised control trials to determine IOP reduction by trabecular procedures like iStent, iStent inject or hydrus combined with cataract surgery versus cataract surgery alone, it was found that trabecular MIGS procedures led to a decrease in IOP by only 1.6–2.3 mm Hg (3.8–8.9%) over cataract surgery which alone provided 21–28% IOP reduction at 2 years post surgery.[1] The decrease in medication attributed to these devices alone was 0.4 at 2 years. This report clearly shows that trabecular stents have very minimal additional benefit in terms of IOP lowering, and the impressive IOP drops being used to convince both patients/surgeons to undergo/adopt these procedures are mainly due to the effect of cataract surgery on the anterior chamber angle and improving the facility of outflow. Even this mild IOP reduction may be exaggerated due to industry sponsorship bias as all trials discussed in the above report were industry-sponsored, and nearly all had first or corresponding authors with a financial interest in the specific companies whose device they were evaluating.

Several MIGS studies wash out the medications and then report outcomes. In patients who are on long-term medications, there may be drug tachyphylaxis, and this may reverse after a drug holiday due to an increase in drug-receptor sensitivity. So, even a single drug may be very effective when introduced after a drug holiday and lead to a significant reduction in IOP. This can be a major factor in the trial showing a reduction in the number of medications, which may not be an accurate depiction of the actual outcomes.

IOP lowering with devices that dilate the SC over 3 hours (Hydrus) is generally superior to implanting trabecular bypass devices at 2 pinpoint locations (iStent inject) although medication-free target IOP is unlikely to be achieved by these devices even for early glaucoma (18 mmHg). The implantation of 3 stents (iStent infinite) may have potentially better IOP lowering outcomes and has been approved as standalone (without cataract surgery) implantable device although long term results are awaited. Incorrect device placement is an important issue in trabecular bypass stents as using anterior segment optical coherence tomography it was found that nearly half of the devices (46%) were completely buried within the TM and thus not draining[2]. Identification of blood reflux and intraoperative documentation of increase in outflow by looking at trabecular blanching /subconjunctival flow with forceful (dye enhanced) irrigation may provide an intraoperative clue towards correct stent placement.

Non-Drainage of MIGS implants due to absence of adjacent collector channels is another concern as the outflow pathways are non-uniformly distributed across the circumference of the eye. The proper placement of the iStent within the TM does not guarantee that aqueous will drain and exit through the collector channels as there are a lot of variations in the position of these collector channels[3]. Increasing the number of stents implanted in the eye may increase the probability of hitting the collector channel outflow pathway, but this cannot guarantee outflow due to its inherent limitations, as highlighted above. Further studies are required to evaluate anatomical landmarks for guiding stent implantation, signs for correct location (like back flush of blood), and functional assessments at physiological pressures post-implantation.

Dye-assisted fluid waves can be used after each implant to evaluate the outflow, although this is done under forced high pressures, which may give a false positive result. Ideally the outflow should be evaluated at physiological pressures using tracers such as ICG with aqueous angiography [4] or preferably non-invasive techniques in the future such as Haemoglobin video imaging.

Trabecular wound healing leads to failure of angle based MIGS procedures and there is often a need for repeat surgery. Larger the incision on the TM , higher the risk of bleeding and higher the risk of a fibrotic response which may even lead to a rebound increase in IOP due to closure of previously functional aqueous outflow pathways[5]. While any incisional/excisional procedure on the TM is bound to fail over time due to wound healing, the same is also true for trabecular bypass stents. Histopathologic examination of TM changes after trabecular bypass stent implantation has revealed significant fibrotic changes and membranes over the stent, which can contribute to device failure over time.[6]

The need and cost of repeat surgery, preferably using a different surgical technique, is also an important consideration, as target IOP may not be achieved or sustained with canal-based implant surgery. This should be an important part of counselling the patient and overall patient management decisions.

The TM is a dynamic pump involved in regulation of IOP and also acting as a filter (with active phagocytosis) for aqueous before it drains into the venous system. Whatever nature has placed in the human body has a purpose to it and removing it without understanding its complete function may be a mistake. For example if a water drain gets blocked in our house, there are two options-either we clean the drain or replace it. If we remove the drain, although there may be immediate flow but eventually the debris will block it in such a fashion that the solution will turn out to be worse than the problem. That is why I am against the procedures which involve damaging the canal across 360 degrees in POAG (like GATT) as there is now accumulation of aqueous debris further downstream, there is a major wound healing response and trabecular tissue is not available for a subsequent treatment (like SLT, another MIGS and new drugs which remodel the TM like rho-kinase inhibitors). [7]

The extent of incision/excision on the TM is not proportional to the amount of resistance eliminated, and opening a wider area of the SC does not translate into a higher IOP reduction. Studies on the outflow resistance in enucleated human eyes have shown that 1 clock hour and 4 clock hours of trabeculotomy showed 41–60% and 79–85% of the effect respectively produced by 12 clock hours trabeculotomy[8]. (It is important to remember that even after 360 trabeculotomy only 50 % of the total outflow resistance is eliminated since we are only removing the trabecular resistance and the remaining resistance to outflow lies within the intrascleral outflow system which is not being targeted in angle based MIGS) . It makes sense to operate no more than 1 quadrant 90 degrees of the TM to keep a balance between IOP lowering efficacy vs complications - wound healing and also keep adequate TM available for subsequent medical/laser/surgical therapy.

Techniques which try and restore the physiological functioning of the TM may be preferred over incisional techniques. In this regard visco-dilatation of the canal and use of SLT may be good options. SLT may give an indication about the effectivity of future MIGS as IOP lowering after SLT indicates a well functioning outflow system. It can also be used for additional IOP lowering when MIGS fails. A new concept emerging is to pre-treat the TM with rho-kinase inhibitors to improve outflow and then perform angle based MIGS although further research is required to validate this concept.

Minimally invasive bleb surgery (esp. Xen and Preserflo) which were proposed as minimally invasive replacements for trabeculectomy have failed to deliver their promise as most studies show that IOP lowering with trabeculectomy is better than these MIBS techniques . Trabeculectomy achieves a lower target IOP as compared to any other technique and still remains the " Gold Standard" as the surgical procedure of choice for advanced glaucoma.

A new concept that we have proposed is that for incisional/excisional MIGS, surgery on the (low outflow) temporal TM [9]. (rather than the usual high outflow nasal TM) may be preferred and the aqueous outflow which is maximal in the nasal quadrants should be preserved especially when you are operating early in the disease where TM is still functional. This requires further validation with more studies targeting other areas of the TM (esp. inferior).

Finally can we impact impact Glaucoma Blindness worldwide with such expensive MIGS techniques? According to the latest poverty statistics, a huge majority—84% of the world population–live on less than $30 per day. That means there are 6.7 billion people or more who cannot afford these devices, which cost between $1500 and $2000 USD. Thus, on a global scale, these devices are of not much value in decreasing glaucoma morbidity and alleviating blindness. With limited funding available, most countries cannot afford to divert funds for these devices without impacting treatment for other life-threatening diseases. We need to drive innovation towards low cost MIGS and also the development of pharmacological agents that inhibit trabecular wound healing post MIGS to augment its long term success.

The development of effective and affordable alternatives for MIGS is the need of the hour. Surgical techniques that strip a portion of the TM and expose the SC have been shown to be as effective as microstents. Limited excision of the TM (goniectomy) may be a better option than limited incision (goniotomy) as the latter leaves TM remnants which can fuse and close the incision. The best option may be if one combines viscodilatation of the canal with a goniectomy as it works by a dual mechanism and also protects the outer wall of the canal (expanded from viscoelastic) from collateral damage (which promotes scarring). Out of these, our favourite is the BANG (excising upto 3 clock hours of the TM), which has the lowest cost, does not need any special instrumentation, has a small learning curve and can be done in any region of the world. 10 We have recently introduced a new modification known as visco-BANG, where we introduce a 30 gauge needle into the canal, dilate it with viscoelastic to decrease the risk of injury to the outer wall of SC, cut the TM and push viscoelastic into the adjacent intact SC to viscodilate and increase outflow (it also helps to tamponade bleeding). [11]

MIGS in primary angle closure disease is an exciting area which is still being evaluated for its safety and efficacy as cataract surgery alone is very effective in lowering IOP in PAC/PACG. MIGS procedures require the use of gonio- synechialysis to remove PAS and expose the TM before performing any ab-interno canal surgery. There is a high risk of recurrence of PAS after canal based MIGS procedure and pilocarpine may be used in the initial post operated period to prevent this complication.

Endoscopic cyclophotocoagulation is a useful technique which can be used in conjunction with cataract surgery especially when operating on advanced PACG cases as a lower target IOP is required which is not possible with cataract surgery alone or its combination with angle based MIGS. Trabeculectomy can then be performed as a second stage procedure if required (after 6-12 months) and not combined with the phaco which gives worse IOP outcomes as compared to a sequential surgery (phaco first – trab later).

The Future

There is a huge investment into the research and development of MIGS procedures by industry and this segment continues to evolve rapidly. Emergence of laser based surgery like the FLIGHT procedure (femtosecond laser image guided trabeculotomy) titratable , titratable/adjustable surgical systems, drug releasing trabecular-bypass stents, uveal spacers with ciliioscleral interposition and continuous IOP monitoring with intraocular sensors (EYEMATE) are exciting advances in this regard. Non invasive aqueous outflow imaging techniques are also under development which can identify the exact location of the collector channels for implant placement and objectively evaluate the impact of MIGS on increasing the aqueous outflow. The development and use of intracameral anti-fibrotic agents is the need of the hour as trabecular wound healing is the main cause for MIGS failure. Low-cost MIGS innovations (like visco BANG), which can be applied on a global scale, need to be popularized and put through rigorous scientific trials, including head-to-head comparisons with trabecular stents, to establish their safety and effectiveness, especially independent of cataract surgery. The future looks bright as trabecular MIGS becomes the standard of surgical care for early-moderate glaucoma with a well-proven track record of safety and effectiveness (in reducing visual field progression, medication burden, and need for subsequent filtration surgery) and the continuous development of new technologies for improving it further. In conclusion angle based MIGS is a safe surgical technique with limited IOP lowering capability which can on its own generally reduce upto 1 topical medication for a glaucoma patient and help in preventing disease progression and the need for subsequent surgery. Surgeons must give due respect to the TM and opt for techniques which cause minimal injury to this vital structure and adopt new techniques after going through evidence based publications without industry bias to serve the best interest of glaucoma patients.[12]

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Anterior Segment imaging for MIGS

Session I

Dr. Prasanna Venkatesh Ramesh

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INTRAOPERATIVE GONIOSCOPY & MICROSCOPE SETTINGS

Abstract:

In this audiovisual presentation titled "Intraoperative Gonioscopy & Microscope Settings" the essential role of gonioscopy in enhancing the outcomes of minimally invasive glaucoma surgery (MIGS) is covered.[1,2] This exploration begins with a detailed overview of various direct gonioscopes, including the Koeppe Goniolens, Swan Jacob Goniolens, Richardson-Shaffer's Goniolens, Thrope Goniolens, Barkan Goniolens, and Layden Direct Goniolens, and highlights recent advancements such as the iPrism S and Sx, Katena handheld, Katena hands-free, and Volk Surgical Gonio Lens. A comprehensive algorithm encompassing the pre-operative phase (anesthesia selection), intra-operative phase (microscope and head tilting techniques, gonio lens selection, seat and hand positioning, corneal incision, soft shell technique, foot pedal adjustments, and goniolens docking and manipulation), and post-operative phase (goniophotography) is shown. The microscope and head tilting technique involves a temporal approach to the nasal angle, with the patient's head rotated 30-40 degrees nasally and the microscope adjusted temporally by the same degree. This method integrates manual pencil marking and smartphone applications to ensure precise tilting and optimal angle visualization. The presentation also addresses common challenges encountered during direct gonioscopy, such as excessive pressure causing corneal striae, reflections from scratches, collapse of Schlemm's canal, and managing blood reflux in the anterior chamber, including techniques for clearing the blood field. Furthermore, the importance of simulated training is emphasized, employing detailed angle anatomy within a 3D eyeball framework in an augmented reality environment, with the introduction of an innovative, cost-effective, and portable 4D holographic simulator protected by patent for training purposes.[3]

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INTRAOPERATIVE OCT IN MIGS

Abstract:

The intra-operative optical coherence tomography (iOCT) was introduced to offer better visualization and depth appreciation during ophthalmic surgery, which the traditional surgical microscope lacked, with its only enface intra-operative view. Initially, iOCT systems were portable and handheld. However, modern systems have been integrated with surgical microscopes, improving both platform stability and surgical efficiency. While the iOCT has been most utilized in vitreoretinal and corneal surgeries, its use has also been described in glaucoma surgeries, including trabeculectomy, bleb needling, goniosynechiolysis and glaucoma drainage device implantation. Most recently, the use of the iOCT has been explored in minimally-invasive glaucoma surgery. The iOCT may be used in trabecular bypass MIGS, where it may reduce the risk of over- and under-implantation of the G2/G2W iStent inject; and ensure optimal placement of the Hydrus Microstent, particularly when confirmatory visualization of the three windows of the stent in the Schlemm's canal post-implantation may be impeded by dense iris processes or a heavily-pigmented trabecular meshwork. The iOCT may also aid in the ab-externo implantation of stents in minimally-invasive bleb surgery, for both the XEN45 Gel Stent and the Preserflo Microshunt. In Preserflo Microshunt implantation, the iOCT can ensure the safe entry of the guide needle through the angle and into the anterior chamber; it may be used to ensure no obvious blockage or occlusion within the stent lumen; and it helps to confirm the safe deployment of the stent just anterior to the iris and away from the cornea, to minimize the risk of endothelial cell loss.

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AQUEOUS ANGIOGRAPHY GUIDED MIGS

Abstract:

Aqueous Angiography (AA) is a recently introduced technique for in vivo, real time, functional assessment of conventional aqueous humor outflow under physiological conditions. It utilizes tracer dyes like indocyanine green (ICG) dye to visualize the flow of aqueous through the aqueous channels.

Procedure of AA Imaging:

0.1ml of 0.1% ICG dye is injected intracameral prior to or during any planned intraocular surgery like phacoemulsification. The flow of the dye through aqueous channels is imaged using the Flex Module of the OCT machine in the operating theatre (OT) with the patient lying supine on the OT table.

Revelations by AA:

AA has revealed wide variations in aqueous outflow, with the most common being a segmental aqueous outflow along the limbus. AA helps to identify high-flow regions (area of increased angiographic signals) and low-flow regions (area of decreased angiographic signals). This has enabled us to perform targeted minimally invasive glaucoma surgeries (MIGS) for better results of such precise surgical procedures.

Case reports have shown different clinical outcomes achieved with MIGS in AA identified high-flow and low-flow regions including its long-term sequelae. This raised a query whether which is more beneficial? (MIGS in AA identified high-flow region or low-flow region). A pilot randomized control trial was designed to answer the above query and concluded that BANG (Bent ab interno needle goniectomy) in the low-flow region had higher postoperative success at 6 months compared to BANG in the high-flow region. This opens an avenue for performing targeted MIGS, especially trabecular cutting procedures in the low-flow regions (which is generally the temporal quadrant).

AA allows for intraoperative functional assessment of MIGS like iStent inject. It has revealed the presence of non-functional stent despite correct anatomical position, likely due to its placement in the area of collapsed/absent aqueous channels.

With AA in the armamentarium of glaucoma surgeons, it can pave the way for increasing the efficacy of MIGS procedures in the future.

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INTRAOPERATIVE PREDICTORS OF CLINICAL OUTCOMES

Abstract:

Minimally invasive glaucoma surgery (MIGS) has emerged as a popular option for lowering intraocular pressure (IOP) with a favorable safety profile compared to traditional glaucoma surgeries. Identifying intraoperative predictors of success can help optimize patient outcomes. Key predictors include optimal visualization of angle structures using gonioscopy, anterior segment OCT, or other methods. Several new techniques can be used to assess the outflow pathway intraoperatively to achieve predictable success and IOP control with any MIGS procedure. This presentation details the various methods and the advantages and limitations of each technique as intraoperative predictors of success after MIGS. Understanding these predictors can guide surgeons in refining surgical approaches, and ultimately enhancing the efficacy of MIGS in clinical practice.

Session II

Dr. Steven Mansberger
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Chair, Senior Scientist, and Director of ophthalmic clinical trials for Legacy Devers Eye Institute in Portland, Oregon

ROLE OF CATARACT SURGERY IN LOWERING IOP IN POAG/OHT

Abstract:

The presentation covers the IOP lowering caused by cataract surgery alone in patients of Primary Open Angle Glaucoma and

Ocular hypertension. The main IOP lowering effect being reported in trabecular MIGS is attributed to the cataract surgery alone and this serves as an important contributing factor for IOP control. Studies reporting IOP lowering effect of Phaco-MIGS

should have a control arm of phaco alone to decipher the actual IOP lowering response of MIGS should.

Trabecular Cutting Procedures

Session III

Dr. Suneeta Dubey
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TRABECTOME

Abstract:

With the advancement of technology and the advent of minimally invasive glaucoma surgeries (MIGS), new options have emerged to manage angle-based outflow resistance. Trabectome (Neomedix Corporation, Tustin, CA) is an electrosurgical handheld gonio-ablative device used for excisional goniotomy, also referred to as irrigating goniectomy. Approved by the FDA in 2004, the Trabectome has the theoretical advantage of reducing the risk of cicatricial closure of the trabecular cleft. It combines irrigation, aspiration, and ablation functionalities within a single handpiece controlled by a foot pedal. Using a bipolar 550 kHz electrode, it ablates the trabecular meshwork and the inner wall of Schlemm's canal through an ab-interno approach, re-establishing the natural aqueous outflow pathway.

Unlike cautery, Trabectome utilizes plasma energy with a confined heat dissipation cone, minimizing thermal transfer to adjacent tissues. Ablation typically covers 120°-140° of the trabecular meshwork, enhancing aqueous humor drainage and effectively lowering intraocular pressure (IOP). This procedure offers significant advantages, including faster recovery times, fewer postoperative complications, and the potential for earlier glaucoma intervention.

Clinical studies have demonstrated the efficacy of Trabectome in achieving sustained IOP reduction and decreasing dependency on glaucoma medications in various types of adult and childhood glaucoma. Additionally, it can be performed as a standalone procedure, reducing the need for multiple surgical interventions.

In conclusion, Trabectome represents a significant advancement in glaucoma management, providing a safe, effective, and minimally invasive solution for IOP control while improving patients' quality of life.

Dr. Vanita Pathak Ray

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EXCISIONAL GONIECTOMY WITH KAHOOK DUAL BLADE

Abstract:

MIGS has changed the paradigm of the management of mild-to-moderate open-angle-glaucoma. providing more options that can be deployed earlier in the disease spectrum. MIGS can decrease IOP and reduce burden of medications(AGM), is safe and overwhelmingly patient-centric as the post-operative recovery and visual rehabilitation is generally very rapid.

MIGS in the angle follows the physiological-outflow-route –excisional goniectomy by Kahook Dual Blade(KDB) is one such procedure. It is a handheld knife designed to excise a strip of trabecular meshwork(TM) via the elevated parallel cutting edge of the blade–first engaging the TM with its tip and then stretching it via the ramp extending from the tip. A footplate, 230microns, is seated in the Schlemm's Canal (SC) as the blade glides to excise a strip of stretched TM, preventing collateral damage to the outer wall of the SC. The excised strip is then easily removed.

The main indication is an open angle, including those that open after laser peripheral iridotomy, though goniosynaechiolysis can also be performed. It can be done as a standalone procedure or can be combined with cataract surgery. In the former, mean IOP reductions of 11–36% and mean AGM reduction of 15–92% have been reported[1-5] whereas in the latter, corresponding reductions reported are 11–34% and 11–79%.[5-10]

Transient, self-limiting bleeding due to regurgitation of blood via SC, is not uncommon, but commonest complication reported is an IOP spike (3-32%), usually at week 1, the aetiology of which is not well elucidated, but may in part be a steroid response. Re-operation rates reported are in the range of 2-22%. None of the studies reported any significant sight threatening complications.

To conclude, KDB effectively lowers IOP and reduces the medication burden, without compromising safety, in eyes with open angle.

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Dr. Devender Maheshwari

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MICROHOOK AB INTERNO TRABECULOTOMY

Abstract:

BACKGROUND: An ab interno Tanito microhook trabeculotomy (micro-LOT) requires a reusable, specially designed microhook(Inami & Co, Ltd) to cleave the TM and the inner walls of SC. This reusable instrument has a sharpened bent tip, which comes as straight, right-angled, and left-angled, and allows the surgeon to access all quadrants of TM, if desired.Although the prices of many devices are variable, an estimate of the cost of a reusable Tanito microhook is approximately $200 to $220 USD which is a signicantly less than usual cost in the United States than other MIGS procedures like an iStent, KDB, OMNI, or iTrack catheter, which are signi cantly more expensive and single use

SYNOPSIS: This Video starts with a comparative review of different MIGS procedures and authors' views regarding microhooks. Followed by detailed steps of MicroLOT surgery with micro-points and authors' experience. The author also shares his experience of uutilizing microhooks not only in open-angle but also in challenging cases like Primary angle closure, Acute angle closure, Glaucoma associated with coloboma and others. This video also shows a case of MicoLOT coming to the rescue of a surgeon in case of intraoperative Trabeculectomy complication as an alternative to filtering surgery.The video concludes with the author's one-year prospective analysis, which proves Ab interno microhook trabeculotomy (microLOT) combined with phacoemulsication in patients with open-angle glaucoma an efficacious procedure.

Dr. Amit Porwal

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BANG

Abstract:

The phrase 'MIGS' was coined by Dr. Ike Ahmed in 2009. MIGS has revolutionized glaucoma management with minimal tissue trauma, good post-operative recovery, and improved patient satisfaction. There are various approaches for MIGS procedures viz. trabecular meshwork, subconjunctival space, suprachoroidal space, ciliary body. BANG (Bent ab-interno Needle Goniectomy) increasing aqueous outflow from trabecular meshwork and Schlemm's canal by tissue removal through excision of the trabecular meshwork tissue. It bypasses the trabecular meshwork and form a direct pathway to Schlemm's canal for 3-4 or more clock hours. It can be performed combined with cataract surgery or as a stand-alone procedure in phakic, aphakic or pseudophakic patients. Ideal candidate for Phaco plus BANG procedure for beginners is one who is having mild to moderate open angle glaucoma, whose goal is to decrease IOP by 20-30% or in mid-teens, and / or to reduce the number of glaucoma medications. BANG is the only low cost MIGS procedure. All you need is a 25G hypodermic needle (5/8 inch) and a needle holder to bend the tip. A goniotome is fashioned by bending the distal 1 mm of the needle toward the bevel at about 75 to 80 degree angle and is then used to perform a goniectomy for about 120 degrees using a gonioprism. Published literature depicts reduction of IOP and number of anti-glaucoma medications after Phaco plus BANG by 30-50%. Thus MIGS – BANG provides safe new options for IOP reduction and reducing the number of anti-glaucoma medications. It has low risk, low cost and is effective. Because of the above factors BANG has gained popularity in developing countries.

Dr. Sirisha Senthil

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GONIOSCOPY ASSISTED TRANSLUMINAL TRABECULOTOMY (GATT)

Abstract:

Glaucoma management has largely been medical treatment and in those with uncontrolled pressures, trabeculectomy still continues to be the gold standard procedure of choice.

Recently, there has been increasing interest in Minimally Invasive Glaucoma Surgery (MIGS) for treatment of glaucoma. While there are multiple procedures and devices available, cost of the device remains a main hindrance in their acceptance in economically disadvantaged countries.

Gonioscopy Assisted Transluminal Trabeculotomy (GATT) is one such MIGS that targets incising the trabecular meshwork and opening the inner wall of the schlemms canal using a 5-0 prolene suture. The advantages of GATT are ab-interno approach, access to open entire natural drainage system, cost effective, good efficacy and safety profile with minimal complications. Can be performed and effective even in eyes with prior failed glaucoma filtering surgeries. Understanding the technique and few tips will help to perform successful GATT, improve postoperative success and reduce complications.

Canal Dilating and Cutting Procedures

Session IV

Dr. Malik Y Kahook

The Slater Family Endowed Chair in Ophthalmology, Professor and Vice Chair, Dept. of Ophthalmology, Chief, Glaucoma Service, University of Colorado School of Medicine, Aurora, Colorado

CANALOPLASTY WITH THE STREAMLINE SYSTEM

Abstract:

The STREAMLINE Surgical System, developed by New World Medical (Rancho Cucamonga, CA) is an FDA-cleared, single-use device designed for precise intraocular viscoelastic delivery. STREAMLINE features a polymer handset with a surgical-grade stainless-steel cannula, allowing access to the trabecular meshwork via a clear corneal incision. When the actuator button is pressed, it retracts an outer polymer sleeve, enabling the inner cannula to enter Schlemm's canal and deliver approximately 7 QL of ophthalmic viscoelastic fluid per activation, with a maximum of 8 total deliveries. The STREAMLINE Surgical System can be used independently or in conjunction with cataract surgery, creating targeted openings in the trabecular meshwork while simultaneously viscodilating Schlemm's canal. The surgeon also has the option to create titrated incisional goniotomies over several clock hours, tailored to each patient's needs. Clinical studies have demonstrated that this approach effectively lowers intraocular pressure (IOP) and reduces the need for IOP-lowering medications in patients with mild to severe primary open-angle glaucoma, showing both clinical and statistical significance whether used as a standalone treatment or alongside phacoemulsification cataract extraction.

Dr. Syril Dorairaj

MD, FACS, Professor of Ophthalmology Mayo Clinic College of Medicine, Director, Glaucoma Fellowship, Consultant Glaucoma, Anterior Segment Surgery, Mayo Clinic, Department of Ophthalmology, 4500 San Pablo Road, Jacksonville, Florida 32224

AB INTERNO CANALOPLASTY WITH ITRACK SYSTEM

Abstract:

Ab-interno canaloplasty represents a paradigm shift in the management of primary open-angle glaucoma (POAG), offering a minimally invasive alternative to traditional glaucoma surgeries. This technique leverages the natural aqueous outflow pathways to reduce intraocular pressure (IOP), a crucial factor in glaucoma management. By utilizing a fiber-optic illuminated catheter, surgeons can achieve 360-degree catheterization of Schlemm's canal, allowing for the targeted viscodilation of Schlemm's Canal and the collector channels. This module discusses the efficacy and safety of the iTrack Ab-Interno Canaloplasty system. Results from recent studies indicate a significant reduction in mean IOP by up to 35.1% and a decrease in medication use by 53.6% in treated patients. The procedure's compatibility with simultaneous cataract surgery and its favorable safety profile, characterized by minor, manageable complications, underscores its potential as a frontline treatment for POAG. The module further delineates potential side-effects and appropriate treatment pathways.

Dr Steven R. Sarkisian

MD, Founder and CEO
Oklahoma Eye Surgeons,
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USA

AB INTERNO VISCODILATATION & GONIOTOMY WITH OMNI SYSTEM

Abstract:

This presentation shows the use of OMNI Surgical System as a technique of canal based MIGS procedure with the aim of surgically restoring the physiological outflow system. This ab-interno technique using a microcatheter has the option of both dilating the canal to increase outflow and also can perform goniotomy if required with the viscoelastic substance acting as a tamponade. This procedure can be performed as a standalone procedure or in conjunction with cataract surgery.

Dr. Tanuj Dada

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VISCO-BANG WITH A 30 G NEEDLE

Abstract:

Visco-dilatation of the canal of Schlemm followed by removal of the trabecular meshwork (TM) can be performed using a 30 G needle which provides the best fit for intracanalicular surgery. The viscoelastic (sodium hyaluronate 10mg/ml) expands the canal and prevents injury to its outer wall , reduces risk of bleeding and also maintains the anterior chamber during surgery. The 30 G needle is used to make an initial cut into the TM , inject viscoelastic and then excise the TM. Viscoelastic can additionally be injected on either sides of the cut edge of the canal to dilate adjacent outflow channels and restore physiological outflow. This can be used as a alongside phacoemulsification cataract extraction and we prefer to perform this before proceeding with cataract surgery as it this stage the view is pristine and any bleeding subsides during surgery decreasing the risk of post operative hyphema.

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Device MIGS

Session V

Dr. Bryan Ang

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Deputy Head, Glaucoma Service,
Dept of Ophthalmology,
Tan Tock Send Hospital Adj,
Asst Professor, Dept of Ophthalmology,
YLL School of Medicine,
National Univ Consultant, Glaucoma Service,
Dept of Ophthalmology, Woodlands Health Singapore

ISTENT SERIES

Abstract:

The iStent series encompasses a range of microstents which bypass the trabecular meshwork and target the Schlemm's canal, to improve aqueous humor outflow and reduce intraocular pressure, in the treatment of open angle glaucoma (OAG). The G1 iStent is a single, L-shaped stent; the G2/G2W iStent inject comprises a pair of preloaded stents; while the iStent infinite comprises three preloaded stents. The G2/G2W iStent inject is US FDA-approved to be implanted in conjunction with cataract surgery. Preoperative preparation involves selecting patients with mild-to-moderate OAG,with clear angle anatomical landmarks. Good intra-operative gonioscopy is essential to ensure optimal visualization of the angle. Key surgical steps include making a temporal corneal incision, injecting viscoelastic into the anterior chamber and on the cornea, rotating the microscope and patient's head to prepare for intraoperative gonioscopy, and deploying both G2/G2W stents under adequate magnification to ensure proper stent placement. “Trochar bias” should be avoided to reduce the risk of stent under-implantation or dislodgement. The iStent infinite is US FDA-approved for standalone use in eyes with primary OAG uncontrolled by prior medical or surgical therapy. The three stents of the iStent infinite should be implanted at least 2 clock hours away from each other. After implantation of the first stent, singulation/reloading is required for subsequent devices. Luminal blood reflux is confirmation of accurate placement of the iStent device. Post-operative follow-up may be similar to that following routine cataract surgery, while titration of glaucoma medications should be individualized to the baseline severity of glaucoma and pre-operative medication burden.

Dr. Chelvin Sng

Adjunct Associate Professor, National University of Singapore, Medical Director, Chelvin Sng Eye Centre, Mount Elizabeth Novena Hospital, Singapore

HYDRUS MICROSTENT

Abstract:

The Hydrus Microstent is an 8mm implant made from nitinol which drains aqueous directly from the anterior chamber to the Schlemm's canal. It has a trimodal mechanism of action, not only bypassing the trabecular meshwork, but also scaffolds and dilates it over 3 clock hours. Patient selection is important for the success of Hydrus surgery and it is most appropriate for patients with mild to moderate open angle glaucoma, as a phaco-plus procedure. This talk highlights the surgical steps involved in Hydrus implantation, with some tips and tricks for beginner surgeons. There will also be a review of the landmark Hydrus studies and a summary of the study findings.

Minimally Invasive Bleb Surgery

Session VI

Dr. Nathan Kerr

Bio Dr. Nathan Kerr,
MBChB, MD, FRANZCO

XEN IN MIGS

Abstract:

Minimally invasive glaucoma surgery (MIGS) has transformed the surgical management of glaucoma by offering safer, less invasive alternatives to traditional approaches. The XEN Gel Stent, a subconjunctival MIGS device, bridges the gap between conventional filtration surgery and newer minimally invasive techniques, delivering effective intraocular pressure (IOP) control with a favourable safety profile. This presentation provides a comprehensive overview of the Xen Gel Stent, including its mechanism of action and surgical technique. Intraoperative videos highlight best practices and address common complications. Attendees will gain valuable insights into optimising patient selection and enhancing surgical success. This module is aimed at equipping ophthalmologists with practical knowledge to integrate XEN into their glaucoma management arsenal effectively.

Dr. Keith Barton

MD, FRCP, FRCS
Professor of Ophthalmology
Moorefields Eye Hospital and UCL,
London

PRESERFLO

Abstract:

Minimally invasive bleb surgery involves the use of implants like Preserflo to create a subconjunctival bleb and can be used as alternatives to conventional filtration surgery (trabeculectomy). The current video demonstrates the correct technique for implanting Preserflo ab-externo micro-shunt augmented with mitomycin C and also covers the complications that may occur with the procedure and rescue operations.

Special Situations and Complications

Session VII

Dr. Xiulan Zhang
MD, PhD
Professor of Ophthalmology
Zhongshan Ophthalmic Centre (ZOC)
Sun Yat-Sen University, Guangzhou, China

MIGS FOR PACG

Abstract:

This presentation demonstrates the efficacy and safety of MIGS in primary angle-closure glaucoma through surgical videos and extensive clinical research evidence, including evidence from multicenter observational studies and RCTs conducted over the past four years. It highlights the future trend of replacing phacotrabeculectomy (PEI+Trab) with phacogoniotomy after goniosynechiolysis (PEI+GSL+GT) and replacing trabeculectomy with surgical perioheral iridectomy (SPI) combined with goniosynechiolysis and goniotomy (SPI + GSL+ GT).

GT: Goniotomy, ab interno trabeculotomy (120 degree)

Dr. Dewang Angmo
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Dr Rajendra Prasad Centre for Ophthalmic Sciences,
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ENDOSCOPIC MIGS

Abstract:

Endoscopic MIGS includes the use of an endoscope for Endocyclophotocoagulation (ECP), endoscope assisted goniotomy & endoscope assisted Bent Ab interno needle goniectomy (BANG).

ECP is a minimally invasive glaucoma surgery (MIGS) procedure in which an endoscope is used to directly visualize and photocoagulate the ciliary epithelium precisely causing minimal collateral damage. Thus, it decreases IOP by reducing aqueous inflow with least complications.

The minimally-invasive nature of ECP allows for easy pairing with phacoemulsification in patients with coexisting cataract. It is usually performed after IOL insertion through the same clear corneal incision used for phacoemulsification. A slow, continuous wave application of the laser treatment to individual ciliary processes for 180- 270° gives optimal IOP reduction. The procedure is fast, sutureless, and does not damage the ocular surface.

It can be combined with cataract surgery in patients with mild to moderate glaucoma, combined with other MIGS outflow procedures to increase IOP-lowering performed after glaucoma drainage procedures in patients with refractory glaucoma. This unparalleled flexibility makes ECP a valuable tool for patients and surgeons alike, even in this age of seemingly ever-increasing MIGS options.

Dr. Sushmita Kaushik

Professor, Advanced Eye Center
Postgraduate Institute of Medical Education and Research,
Chandigarh

MIGS FOR PEDIATRIC GLAUCOMA

Abstract:

Minimally Invasive Glaucoma Surgeries (MIGS) have recently become a game-changer in glaucoma treatment, offering a promising blend of safety and moderate efficacy and offer promising alternatives to more invasive surgeries, helping to preserve the integrity of the eye while effectively controlling pressure. These surgeries typically result in shorter recovery times and reduced complications, which is crucial for children who may struggle with a prolonged healing processes. Goniotomy or angle surgery is the mainstay of surgical treatment for Primary Congenital Glaucoma (PCG), and is in essence the original MIGS procedure. Various refinements in angle surgery have included trabecular meshwork stripping as by the trabectome or Bent-angled ab-interno needle goniectomy (BANG), Trabectome, and 360 degrees angle treatment by Microcatheter Assisted Trabeculectomy (MAT) or Gonioscopy Assisted Transluminal Trabeculotomy (GATT). As research continues to evolve, MIGS may become a standard approach in pediatric glaucoma management, offering hope for improved outcomes and quality of life for affected children.

This video is designed to initiate the viewer into starting MIGS in children, through an engaging mix of demonstrations, case studies and expert insights. We hope to impart a comprehensive understanding of patient selection, pre-operative strategies and surgical techniques. We to help the attendee initiate MIGS or enhance his/her MIGS expertise.

Dr. Paul Healey

MBBS (Hons), BMedSc (Cell Biology),
MMS(HONS),
MMed (Clinical Epidemiology),
PhD (Medicine), FRANZCO.
Centre for Vision Research,
Westmead Institute for Medical Research
& Save Sight Institutes,
WestMead Clinical School & Sydney Eye Hospitals,
Sydney University

WHAT TO DO WHEN MIGS FAILS

Abstract:

Failure of intraocular pressure lowering therapy is common in glaucoma and MIGS is also subject to this. At present we do not have a good evidence base to guide our clinical decision making when MIGS fails, nevertheless we must make further treatment decisions. This talk describes both investigative and pragmatic approaches when MIGS fails. The investigative approach analyses our decision making and technical skills to refine future decision making. The pragmatic approach guides our practical task of reaching target intraocular pressure. These approaches are based on our knowledge of the physiology and pharmacology of intraocular pressure lowering, as well as the mechanism of actions of the MIGS and its expected range of effect

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Head of Glaucoma research,SERI
Assoc Prof Duke- NUS Graduate Medical School
Deputy Director of MedTech Office, SingHealth

MIGS COMPLICATIONS & RESCUE

Abstract:

"Over the past decade, Trabecular Meshwork Minimally Invasive Glaucoma Surgery (TM MIGS) have transformed glaucoma care, providing patients with safer, less invasive alternatives to traditional surgeries. This presentation will explore the potential complications of TM MIGS and how they can be effectively managed. Complication rates are generally low, yet issues such as Descemet's membrane detachment, peripheral anterior synechiae, endothelial cell loss, iridodialysis, hyphema and implant dislodgement can arise.

Effective solutions, including detailed reattachment techniques for tissues and controlled repositioning methods for stents showcase the skill required in managing these delicate cases. Viewers will gain valuable take home tips from our wealth of experience in this area. The current literature in this area will also be critiqued and summarised to enable surgeons to understand better the consequences of their surgeries. By addressing these challenges, we aim to enhance surgeon preparedness and improve patient outcomes."

Clinical outcomes

Session VIII

Dr. Mona Khurana

Senior Consultant, Glaucoma services,
Sankara Nethralaya Medical Research
Foundation, Chennai, India

CLINICAL OUTCOMES OF MIGS PROCEDURES

Abstract:

Minimally invasive glaucoma surgeries (MIGS) are a diverse group of relatively new procedures that lower intra ocular pressure (IOP) with limited or no disruption to conjunctiva or sclera typically performed in eyes with mild to moderate primary open angle glaucoma (POAG). This presentation provides a comprehensive literature review and discusses the various randomised controlled trials, meta analysis and retrospective studies evaluating the success of various MIGS procedures. Studies comparing MIGS combined with cataract surgery versus cataract surgery alone, as well as standalone MIGS are described. It also includes the technology assessment reports of the trabecular procedures combined with cataract surgery compared with cataract surgery alone. It also sheds light on the cost effectiveness of MIGS procedures in terms of incremental costs per quality-adjusted life- year compared with cataract surgery, IOP lowering medication, and trabeculectomy.

Dr. Shan Lin

Co-Research Director
Glaucoma Center of San Francisco,
USA

REFRACTIVE CONSIDERATIONS IN MIGS PROCEDURES.

Abstract:

New developments in refractive correction with cataract surgery provide opportunities for the glaucoma patient to substantially improve their visual capabilities and quality of life. These advances include Toric IOLs, Multifocal IOLs, Extended Depth of Focus (EDOF) IOLs, Laser Adjustable Lenses (LALs), and technologies to improve the precision of refractive outcomes.

Multifocal IOLs can be appropriate in eyes with no or mild/moderate peripheral field loss and central vision intact. Extended depth of focus (EDOF) IOLs can have less loss of contrast than Multifocal IOLs but still have this risk and should be considered with caution in situations with current or potential field loss that threatens fixation. Toric IOLs can also be considered in patients who do not have substantial central field loss. The new Laser Adjustable Lens allows postoperative correction of the refractive error using a laser in the ultraviolet spectrum.

Ultimately for each individual patient, there are several factors which help to guide utilization of premium lenses including severity of glaucoma, type of glaucoma (traumatic, pseudoexfoliation), daily activities, cost, life expectancy, and prior surgery (trabeculectomy, LASIK). In select patients with relatively intact vision in both eyes, monovision may be a good option.

Additionally, technologies are now available that can help us better assess the orientation for toric IOLs (Verion Digital Marker) and determine the optimal power for the IOL with better precision (intra-operative aberrometry [ORA, HOLOS]).

Finally, a careful discussion with the patient is critical for the best outcomes, depending on their expectations.

Laser Procedures

Session IX

Dr. Paul chew

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National University Health System

MICROPULSE TRANSCLERAL LASER THERAPY

Abstract:

Micropulse transscleral laser therapy (MTLT) is an effective, non-invasive modality to lower intraocular pressure(IOP). The laser technique is simple and fast. No steep learning curve is required prior to performing the procedure. The proposed mechanism of IOP lowering is enhanced uveoscleral outflow through enlarged extracellular spaces. With a good safety profile, it can be applied to a wide spectrum of cases such as primary or secondary, open or angle closure glaucoma irregardless of patients'age. The laser procedure can be combined with cataract surgery, lowering IOP from 18.4 mm Hg to 15 mm Hg IOP and reducing number of medications from 1.8 to 0.5 mean eye drops. When compared to 2 minimally invasive glaucoma surgeries (MIGS), iStent and hydrus, a 12-month case series in National University Hospital, Singapore shows micropulse laser therapy significantly lowers mean IOP [{17.4 mm Hg to 14.8 MTLT; 13.9 to 14.1 iStent); 16.8 to 14.5 mm Hg in MTLT; 17.2 to 15.2 Hydrus}] and reduces IOP lowering medications [{average of 1.6 to 0.2 MTLT, 1.3 to 0 iStent}; 1.5 to 0.2 MTLT, 1.4 to 0.2 Hydrus}]

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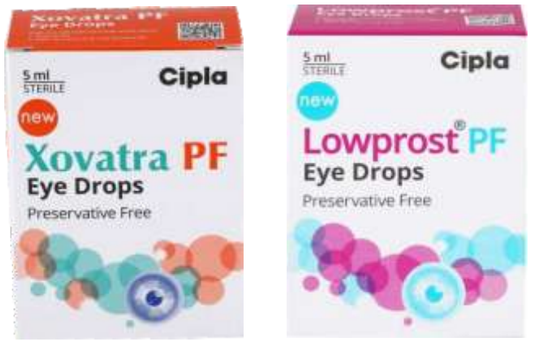

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