

“Minimally Invasive Glaucoma Surgery (MIGS) Is a Poor Substitute for Trabeculectomy”—The Great Debate

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Received: April 16, 2018 / Published online: June 22, 2018
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ABSTRACT

Surgical treatment for glaucoma has undergone a dramatic change over the last decade. Trabeculectomy has been the main surgical procedure worldwide for almost 50 years. However, there is a growth in development of new novel devices and surgical techniques designed to lower intraocular pressure in a less invasive fashion. The term minimally invasive glaucoma surgery (MIGS) has been coined and is the subject of investment, debate and, increasingly, research. The position of MIGS in the glaucoma treatment paradigm is yet to be clearly defined and its ability to replace conventional filtration surgery remains debatable. In this paper two glaucoma specialists were invited to debate the motion that “MIGS is a poor substitute for trabeculectomy”.

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Keywords: Glaucoma surgery; MIGS; Minimally invasive glaucoma surgery; Trabeculectomy

INTRODUCTION

Surgical treatment for glaucoma has undergone a dramatic change over the last decade. Trabeculectomy has been the main surgical procedure worldwide for almost 50 years. However, there is a growth in development of new novel devices and surgical techniques designed to lower intraocular pressure (IOP) in a less invasive fashion. The term minimally invasive glaucoma surgery (MIGS) has been coined and is the subject of investment, debate and, increasingly, research. The position of MIGS in the glaucoma treatment paradigm is yet to be clearly defined and its ability to replace conventional filtration surgery remains debatable. In this paper two consultant glaucoma specialists were invited to debate the motion that “MIGS is a poor substitute for trabeculectomy”.

For the Motion—Philip Bloom, Western Eye Hospital, London, UK

I write in favour of the motion ‘MIGS is a poor substitute for trabeculectomy’, a statement with which my learned colleague Leon Au disagrees; he professes to believe that MIGS can replace

trabeculectomy as the gold-standard in sight-preserving glaucoma surgery. Debates like this can descend to semantics, but that is not the case here—I will argue that the operations are fundamentally different. Each should be offered in different situations, for different indications, in patients with different clinical pictures, in order to achieve different outcomes.

MIGS is a broad term, the definition of which merits discussion for the purpose of this debate. Non-incisional therapies such as selective laser trabeculoplasty (SLT) and all forms of trans-scleral cyclo-modulation (laser and ultrasound) are not traditionally regarded as MIGS so will not be considered, nor will cataract surgery alone when performed to treat angle closure.

I restrict the term MIGS to ab interno drainage procedures that do not require conjunctival incision; included therefore are Endoscopic Cyclo-Photocoagulation (ECP), Goniosynechialysis, Trabectome, iStent, Cypass, Hydrus, Kahook Dual Blade (KDB), ab interno Canaloplasty and Xen (though the need for regular conjunctival and incisional manipulation with Xen makes its inclusion contentious). Excluded are ab externo glaucoma drainage devices including all traditional tubes such as Baerveldt and Ahmed, ‘non-penetrating’ glaucoma surgery such as Deep Sclerectomy, visco-canalostomy or ab externo canaloplasty, Express Shunts and Innfocus devices.

What is the reason for the enduring success of trabeculectomy as the ‘go-to’ surgical glaucoma procedure, and why is it only now that we have started to actively explore high-volume alternatives? The glass half-full (rose-tinted) opinion of trabeculectomy sees it as a cheap, proven, effective, potentially long-lasting and acceptably safe incisional option [1]; at best a perfect, permanent, biological valve. The contrary view is that there is an attrition rate, complications are not infrequent and that the results of the procedure are frustratingly variable—even 2 eyes of the same patient with the same surgeon and same basic technique may turn out very differently.

But at its core the longevity and enduring popularity of trabeculectomy as an effective surgical option cannot be ignored, evidenced by the huge volume of evidence in the peer review

literature supporting its use. Moreover, despite the keen interest in surgical modifications designed to refine the operation and to make it work better, more reliably, consistently and safely [2], it remains a reasonably cheap and simple operation, moderately independent of individual skill and technique. By contrast, the ‘young pretender’, MIGS, is expensive and as yet unproven. MIGS shows promise but experience is limited and long-term results are not known, hence the dearth of scientific publications (and evidence-based references) in the field.

To consider the relative merits of trabeculectomy vs MIGS in perspective, it is worth looking at the whole context of glaucoma treatment. All current glaucoma treatments work via reduction of intra-ocular pressure, a dose-related protective effect correlated to lowering not only in the average pressure but also its diurnal variation. In this regard, all successful laser and surgical treatments should logically be more effective than medicines, the efficacy of which has to be reinforced daily by regular application related to a short, finite duration of action.

However, a traditional advantage of medical treatment has been that different medications may be combined to benefit from three distinct strategies for IOP reduction, namely reduction in aqueous inflow and increase in either conventional (trabecular) outflow or non-conventional outflow. Furthermore, logical application of basic principles has allowed a step-wise approach to medical treatment escalation, leading to logical and refined medical strategies such as switching medications for reasons of non-response or compliance, adding and combining medications.

When trabeculectomy was the only viable surgical option it was a blunt tool in our treatment armamentarium, its main benefit being its reliable and enduring efficacy. Dissatisfaction, principally with side effects and complications of trabeculectomy, led to the advent of glaucoma drainage devices and non-penetrating surgery; clearly these were not the answer as their use in the routine surgical control of glaucoma did not become widespread.

The advent of a variety of MIGS options represents a further attempt to refine the safety and efficacy of surgical intervention;

furthermore, they allow a more logical and step-wise approach to surgery. ECP reduces aqueous inflow; conventional outflow can be restored/enhanced with iStent/Hydrus, bypassed with Trabectome/Xen/KDB; non-conventional outflow can be augmented with Cypass. Escalation of invasiveness and combination of treatment modalities now allow the new and real possibility of a sequential and additive approach to combining surgical interventions in away analogous to our use of medications. In this way MIGS offers the prospect of much greater efficacy than provided by the mere restoration of physiological outflow, one of the original aspirations for the procedure.

Of these treatments, perhaps use of ECP and Cypass offer the easiest and potentially most effective additional treatment options, as they utilise the less commonly employed inflow and non-conventional outflow pathways. In addition, inflow and outflow procedures can be amalgamated—ECP can be performed with iStent, either concurrently or at an interval; or different forms of outflow procedures may be combined—Cypass can be performed after failed or sub-optimal iStent or ‘conventional’ drainage surgery in an attempt to avoid riskier, more invasive surgery. A further advantage of MIGS is the ability to combine surgery with phacoemulsification; phaco-trabeculectomy is no longer widely performed but then again, combined surgery is not the subject of the debate at hand.

A potential limitation of trabecular restoration in patients with glaucoma is that, in the presence of normal aqueous inflow, Schlemm’s canal drainage routes seem to have a physiological ‘floor’ of around 16 mmHg due to downstream resistance to flow [3]. Further lowering would require additional aqueous suppression treatment, a real disadvantage if low IOP is needed or medication use is to be avoided. By contrast, both conventional and non-conventional outflow procedures potentially bypass this ‘choke-point’, leading to lower IOPs but also raising the possibility of hypotony from overdrainage.

MIGS devices are unarguably expensive, largely due to development costs being recouped by the commercial entities that developed

them. Proponents argue that the extra cost is defrayed by reduced need for intensive follow ups, but this is yet to be proven. Whilst this may be the case for a device such as the iStent, successful use of devices such as Xen still requires intensive follow up due to the common need for post-operative manipulations, over 50% in one series reported by Leon Au [4]. The same may be true for devices such as Cypass, early personal experience of which has demonstrated high effect magnitude in some patients which therefore may require close monitoring.

Devices that have a small unit effect may need to be implanted in costly multiples. Furthermore, if the effect is sub-optimal or if the device later fails, the health economics alter and may well ultimately favour conventional drainage surgery, as the true price comparator then is not drainage surgery but only the relatively cheap medications that MIGS spares. Assessment of quality of life (QoL) and cost/benefit differences between different treatments will require reasonable follow up for meaningful analysis—follow up should be for perhaps 5–10 years as long-term effect is important; if MIGS devices fail and trabeculectomy is still needed, this will greatly alter results. Finally, many QoL ‘instruments’ do not include assessment of drop use so may not be an appropriate tool for a MIGS/trabeculectomy comparison.

But is trabeculectomy really such a bad option? Can the enormous cost of, say, 1–2 MIGS procedures that may need to be performed in order to prevent (say) 50% of trabeculectomies be justified in fiscally responsible health economical terms, especially in the context of a model of healthcare for which the British public pay relatively little—as a proportion of gross domestic product—compared with other developed nations?

Ultimately the widespread adoption of MIGS will probably come down to assessment of safety vs efficacy. MIGS procedures that are inferior to trabeculectomy in efficacy will only be widely adopted if they have significant safety benefits, so it is appropriate to consider the individual efficacy vs safety profile for the most commonly performed MIGS procedures. For procedures performed in combination with cataract surgery it is always challenging to

isolate the effect of the MIGS procedure from that of cataract surgery alone.

ECP may be considered the original MIGS procedure, as it has been performed for almost 30 years. Ultimately its wide adoption has not been limited by the original concerns over safety, but by the extent and duration of the overall IOP effect. Its place should probably continue to be early in the treatment paradigm in combination with cataract surgery or in later cases, following failed or sub-optimal response to drainage/tube surgery.

Xen showed initial efficacy promise but has not fulfilled early safety and simplicity hopes, largely due to the frequent need for post-operative manipulations such as needlings, and continued incidence of bleb-related complications. iStent is probably still the safest MIGS procedure, but one of the least effective and most expensive. Cypass utilises a novel pathway whose longevity is unknown; it has been described as converting a ‘potential space into to a space with potential’ [5]. The word potential feels accurate—it is promising but as yet unproven. The most enduring and successful MIGS will work for long periods, but their later failure will not compromise future alternative surgical treatments.

In contrast to MIGS [4], trabeculectomy continues to be our best single ‘fit & forget’ option. The natural comparator for trabeculectomy is still other forms of ‘conventional’ drainage such as glaucoma drainage tubes and maybe the forthcoming Innfocus device, but to date trabeculectomy has yet to be bettered; twenty-first century trabeculectomy is an increasingly safe and effective procedure [1].

In the absence of widespread evidence about new procedures, my side of this debate has of necessity been somewhat of a personal, common-sense opinion based on the clinical perspective afforded by many years of practical experience. However, proof clearly needs to be gathered to examine and challenge these views.

Surely the best advice when faced with a challenging clinical scenario is, as ever, to ‘treat the patient in front of you’. Consider individual clinical parameters and try to understand your patients’ own perception of risk and benefit. In early disease, there are many options and often

time to try a variety of treatment options. In a patient with advanced glaucoma, it cannot be appropriate to offer a treatment of unproven efficacy or longevity. Sadly, the decision to intervene surgically is put off repeatedly, leading to surgery being performed too late, which is why patients are older; we should be intervening earlier.

It is apparent from the foregoing that the existence of MIGS raises the level of sophistication and complexity in glaucoma surgical management, making it more ‘granular’, titratable and refined. It is simplistic to regard the choice between MIGS and Trabeculectomy as binary; the motion of this debate is clearly correct, as in reality the two options under consideration are rarely considered in clinical scenarios that make them competing surgical strategies, rather they are entirely complimentary therapies. In other words, MIGS is a poor substitute for trabeculectomy because it is no substitute at all; its existence reflects a completely different and new approach to surgical management.

There is an interesting corollary consideration; it has been suggested that the simplicity of MIGS procedures makes them appropriate for use by non-glaucoma specialists. In fact, although the procedures are simple, the decision-making around their selection is anything but, so in my opinion the selection and application of MIGS in the glaucoma treatment paradigm should remain solidly within the purview of glaucoma sub-specialists.

Gus Gazzard has asked: ‘Whither MIGS’ [6]? He writes ‘I foresee a stepwise approach for mild to moderate disease ... (that) leads on to true ab interno MIGS procedures, with or without lens surgery. More invasive conjunctiva-involving stents might then be used for more severe disease or those who fail initial efforts. Alongside this, traditional mitomycin or anti-VEGF augmented trabeculectomies will still be necessary for those needing near—10 or below—10 mmHg IOPs or presenting with advanced disease, while Tube surgery will likely remain the mainstay of surgical intervention for complex, secondary glaucomas and failed previous surgery’.

Ike Ahmed, a keen proponent of MIGS, has stated: “A common misperception of MIGS is

that it needs to be compared with the gold standard of MMC-trabeculectomy to show its effectiveness; this inappropriate interpretation is based on the idea that MIGS procedures are designed to replace conventional filtering surgery. In fact, MIGS devices are designed to address the treatment gap that exists between medical therapy and more aggressive traditional surgical options” [7].

The statement ‘MIGS is a Poor Substitute for Trabeculectomy’ is therefore clearly a ‘no-brainer’; we are nowhere near the point of accepting Leon Au’s enthusiastic assertion that there exists a new gold standard for the surgical management of glaucoma; that remains trabeculectomy.

Against the Motion—Leon Au, Manchester Royal Eye Hospital, UK

As we look forward to celebrating the 50th anniversary of trabeculectomy, one cannot ignore the recent explosion of new surgical glaucoma treatments on the scene [8]. Never before have we seen such an intense level of clinical and financial investment in developing the “perfect” glaucoma treatment for our patients. Although the recipe for perfection has yet to be agreed, the ultimate goals of lowering intraocular pressure (IOP), preventing disease progression and sight loss are the desired ingredients. MIGS has been adopted by many glaucoma surgeons worldwide over the last decade and there is a growing body of evidence of its safety and efficacy. In this article I shall debate against the motion that “MIGS is a poor substitute for trabeculectomy”. In fact by examining the evidence carefully and applying them to the right clinical context, MIGS most certainly can be a substitute for trabeculectomy.

Glaucoma is a multifactorial disease, but IOP remains the only modifiable factor currently available. In the majority of primary open angle and secondary glaucoma, IOP is raised leading to optic nerve damage and visual field loss. The surgical treatments of raised IOP mostly focus on improving aqueous outflow. For the past 50 years aqueous has been diverted into the subconjunctival space via trabeculectomy,

while there’s growing evidence that the obstruction lies within the trabecular meshwork and Schlemm’s canal [8]. Over the last decade technologies have been developed to overcome some of these obstructions to restore physiological outflow. Trabecular meshwork could be removed using the Trabectome (NeoMedix, USA) or Kahook Dual Blade (New World Medical, USA), bypassed by inserting an iStent (Glaukos, USA) or Hydrus Microstent (Ivantis, USA); the Schlemm’s canal can be dilated using ab-internal canaloplasty (Ellex, Australia). Aqueous can also be diverted into the suprachoroidal space via Cypass stent (Alcon, USA) and into the subconjunctival space via the Xen gelatin implant (Allergan, USA) [8].

We are practicing in the era of patient centered care. It is very important to involve our patients in the decision-making when choosing our surgical treatments. Glaucoma is mostly an asymptomatic condition and our treatment goal is to keep it that way. In spite of an understandable fear of sight loss, most of our patients would prefer the least invasive intervention. Ideally any surgery performed should have a low risk profile, short hospital stay, minimal postoperative hospital visits and short recovery period. Hence the concept of minimally invasive glaucoma surgery HAS to be the future; we may not have reached that goal with the current form of MIGS, but the principles need to be embraced.

Trabeculectomy has been shown to be an efficacious treatment in lowering IOP but its drawbacks have also been well reported [1, 9]. The National Survey of Trabeculectomy reported a high rate of complications including hyphaema, shallow anterior chamber, hypotony, cataract and visual loss [9]. These have mostly been reduced by modern trabeculectomy techniques, but the rate remains significantly higher than any of the MIGS procedure [1]. Moreover, trabeculectomy requires an intensive follow up regime in the first 3 months and over half of patients require some form of bleb manipulation in the form of massage, suture adjustment or needling/SFU injections [10, 11].

MIGS cannot be a substitute for trabeculectomy if it is not efficacious in lowering IOP.

Fortunately there is a growing body of evidence supporting MIGS efficacy. Schlemm's canal based procedures (Trabectome, iStent or Hydrus Microstent) have all been shown to lower IOP significantly to 16–17 mmHg while offering a significant reduction in medication [8]. Suprachoroidal stent (e.g. Cypass) has also demonstrated a similar level of pressure lowering [8]; this effect is often augmented by concurrent phacoemulsification, but standalone procedures have been shown to be efficacious, too [12]. For example, iStent injects have been shown to be more efficacious than double or triple medical therapy in patients with uncontrolled IOP [1], while Hydrus Microstent demonstrated superior IOP lowering and medication reduction when compared to selective laser trabeculoplasty [13]. In the Duette study where a standalone Cypass stent was inserted in patients who were medically uncontrolled awaiting filtration surgeries, a significant 35% reduction of IOP was observed at 12 months and 83% of patients did not proceed to formal filtration surgery [14]. For the purpose of this debate, that meant MIGS was the substitute for trabeculectomy in 83% of cases, at least for a year.

Most ab-internal MIGS procedures are an ideal solution to tackle concurrent cataract and glaucoma. RCTs have shown that combined phacoemulsification with iStent, Hydrus or Cypass offer extra IOP lowering with fewer medications than phacoemulsification alone [8]. Moreover, the visual recovery and safety profile are almost the same as phacoemulsification alone. On the contrary, combined phaco-trabeculectomy offers inferior IOP lowering results when compared to trabeculectomy alone, while the visual recovery is prolonged and the need for postoperative bleb management is increased [15]. Given the correct patient profile phaco-MIGS would actually be the preferred option over phaco-trab, especially when a low target IOP is not required.

When a lower target IOP is required, Xen implant can be considered both as a standalone procedure or combined with cataract surgery. Published results demonstrated the ability to achieve a lower teen IOP at 12 months, but with a higher level of postoperative care required than Schlemm's canal surgery [8, 16].

Nonetheless, the rate of complication and visual loss remained low and the postoperative journey is more favourable for our patients than trabeculectomy. In a retrospective multi-centre study the efficacy of Xen implant was shown to be almost identical to trabeculectomy [17]. While we cannot fully eliminate case selection bias in this retrospective study, it at least demonstrates the potential for MIGS procedures to be a substitute for trabeculectomy under the right circumstances.

Since open angle glaucoma is not a curable disease, the ability of any surgical procedure to offer lifelong pressure lowering is important. On the other hand, one must not forget the demographic of the patients we are treating. The majority of patients at diagnosis are elderly and their life expectancy needs to be taken into account. The current life expectancy in the UK is approximately 81 years, longer for females and shorter for males. Studies based in Oxford, UK, demonstrated that 30% of glaucoma patient died within 10 years of diagnosis, 44% died within 15 years [18]. In fact the average length of time from diagnosis to death was 7.54 years. The average age of patients requiring glaucoma surgery is often high; the mean age is 70 years old for trabeculectomy while combined phaco-iStent or hydrus is around 75 years old [1, 8]. Considering the average life expectancy is 81 years, the desire for life-long efficacy needs to be put into context. In fact in a 10-year follow up series of phaco-deep sclerectomy, the authors found that half of the patients died during the study period [19]. Medium term results (over 5 years) of MIGS procedure are already emerging supporting a continuing lowering in IOP and medications [8]. With longer follow up we would no doubt observe increasing surgical failure, but the benefit these procedures offer in that all important 5–7 year period for this group of elderly patients is invaluable.

In many ways glaucoma treatment is a race against time, lowering IOP to slow down progression in order to preserve quality vision during our patient's lifetime. MIGS have been shown to lower IOP and medication burden in a patient-friendly, low-risk fashion. MIGS may not offer a very low target IOP or work well in

more complicated secondary glaucoma. However, when applied to the right patient at the right time of the disease process, its efficacy is unquestionable. Just over a decade ago, the common glaucoma surgical question we asked ourselves in clinical practice would be the infamous: “to trab or not to trab....that is the question!” There is no doubt that thousands of glaucoma patients have had their sight saved by successful trabeculectomies, while the unfortunate minority have lost sight from their complications. Such a binary surgical option has in the past led to patients undergoing invasive procedure for mild disease (e.g. uncontrolled ocular hypertension), or worse, not getting the surgery they needed due to the fear of complications. The wait for the solution is over. We now have an array of surgical options for different patients at various stages of disease. For some (or maybe many), MIGS would be the right answer when medical therapy fails before visual threatening glaucomatous damage sets in. After all, not every patient requires a pressure of 10 mmHg for 10 years.

ACKNOWLEDGEMENTS

We would like to thank David Broadway, Consultant ophthalmologist, Norwich, UK for organizing this debate that originally took place at the Royal College of Ophthalmologist Congress in 2017. We are also grateful for his input in this manuscript.

Funding. No funding or sponsorship was received for this study or publication of this article.

Authorship. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Disclosures. Author Phil Bloom has no financial disclosures while Leon Au has received honorarium for work conducted, travel and

research support from Alcon, Allergan, Glaukos, Ivantis, Iridex, Santen, Thea and Visufarma.

Compliance with Ethics Guidelines. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

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REFERENCES

1. Kirwan JF, Lockwood AJ, Shah P, Macleod A, Broadway DC, King AJ, McNaught AI, Agrawal P. Trabeculectomy in 21st century: a multicentre analysis. *Ophthalmology*. 2013;120(12):2532–9.
2. Khaw PT. More flow study. *Clin Exp Ophthalmol*. 2002;30(Sup):A45.
3. Overby D. Basic science behind trabecular meshwork surgeries. *Acta Ophthalmol*. 2013. <https://doi.org/10.1111/j.1755-3768.2013.1734.x>.
4. Tan SZ, Walkden A, Au L. One-year result of XEN45 implant for glaucoma: efficacy, safety, and postoperative management. *Eye*. 2018;32:324–32.
5. Moisseiev E, Loewenstein A, Yiu G. The suprachoroidal space: from potential space to a space with potential. *Clin Ophthalmol*. 2016;10:173–8.
6. <https://www.rcophth.ac.uk/wp-content/uploads/2016/05/CN-Focus-Spring-2016.pdf>.
7. Ahmed I. MIGS and the FDA: what's in a name (editorial)? *Ophthalmology*. 2015;122(9):1737–9.
8. Manasses DT, Au L. The new era of glaucoma micro-stent surgery. *Ophthalmol Ther*. 2016;5(2):135–46.
9. Edmunds B, Thompson JR, Salmon JF, Wormald RP. The national survey of trabeculectomy III. Early and late complications. *Eye (Lond)*. 2002;16(3):297–303.

10. King AJ, Rotchford AP, Alwitry A, Moodie J. Frequency of bleb manipulations after trabeculectomy surgery. *Br J Ophthalmol*. 2007;91(7):873–7.
11. Rodriguez-Una I, Azuara-Blanco A, King AJ. Survey of glaucoma surgical preferences and post-operative care in the United Kingdom. *Clin Exp Ophthalmol*. 2017;45(3):232–40.
12. Kerr NM, Wang J, Barton K. Minimally invasive glaucoma surgery as primary stand-alone surgery for glaucoma. *Clin Exp Ophthalmol*. 2017;45(4):393–400.
13. Fea AM, Ahmed II, Lavia C, Mittica P, Consolandi G, Motolese I, Pignata G, Motolese E, Rolle T, Frezzotti P. Hydrus microstent compared to selective laser trabeculoplasty in primary open angle glaucoma: one year results. *Clin Exp Ophthalmol*. 2017;45(2):120–7.
14. García-Feijoo J, Rau M, Grisanti S, Grisanti S, Höh H, Erb C, Guguchkova P, Ahmed I, Grabner G, Reitsamer H, Shaarawy T, Ianchulev T. Supraciliary micro-stent implantation for open-angle glaucoma failing topical therapy: 1-year results of a multi-center study. *Am J Ophthalmol*. 2015;159(6):1075–81.
15. Ogata-Iwao M, Inatani M, Takihara Y, Inoue T, Iwao K, Tanihara H. A prospective comparison between trabeculectomy with mitomycin C and phacotrabeculectomy with mitomycin C. *Acta Ophthalmol*. 2013;91(6):e500–1.
16. Tan SZ, Walkden A, Au L (2017) One-year result of XEN45 implant for glaucoma: efficacy, safety, and postoperative management. *Eye (Lond)* 32:324–32.
17. Schlenker MB, Gulamhusein H, Conrad-Hengerer I, Somers A, Lenzhofner M, Stalmans I, Reitsamer H, Hengerer FH, Ahmed IIK. Efficacy, safety, and risk factors for failure of standalone Ab Interno gelatin microstent implantation versus standalone trabeculectomy. *Ophthalmology*. 2017;124(11):1579–88.
18. Shahid H, Salmon JF. Fifteen-year mortality rate and visual outcome in newly diagnosed chronic open-angle glaucoma. *Br J Ophthalmol*. 2013;97(2):235–6.
19. Mercieca K, Shevade B, Anand N. Outcomes of combined phacoemulsification and deep sclerectomy: a 10-year UK single-centre study. *Eye (Lond)*. 2015;29(11):1495–503.