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Editorial

Advances in Glaucoma Surgery

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Glaucoma is one of the leading causes of irreversible sight loss worldwide, with a prevalence of 64.3 million in 2013 and an estimated increase to 111.8 million by 2040 [1]. The initial treatment for glaucoma usually comprises topical medication, but further procedures depend on the type of glaucoma, disease stage and severity, and several individual factors, including age, life expectancy, treatment adherence, quality of life, and both patients' and clinicians' personal choices. Irrespective of all these factors, surgical intervention may still be required in those patients with significant progression and uncontrolled disease despite maximum medical therapy [2].

Since its inception over 50 years ago, trabeculectomy has been the most common glaucoma surgery performed globally [3], although studies from the United States have demonstrated a decreasing trend in trabeculectomy cases in favor of newer surgical techniques such as minimally invasive or less invasive glaucoma surgical devices [4]. These span a large variety of true microinvasive invasive glaucoma surgeries or MIGS, defined by an 'ab interno' intracameral microincisional approach [5–7], and bleb-forming subconjunctival drainage devices such as the PreserFlo™ Microshunt (Santen, Miami, FL, USA) and Xen-45™ (Abbvie/Allergan, Irvine, CA, USA). The former can further be subdivided into 'cutting' MIGSs such as the Kahook Dual Blade™ (KDB, New World Medical, Rancho Cucamonga, CA, USA) and Trabectome™ (NeoMedix Corp., San Juan Capistrano, CA, USA), 'Trabecular Meshwork stent bypass' MIGSs such as the iStent™ (Glaukos, Aliso Viejo, CA, USA) and Hydrus™ (Alcon, Fort Worth, TX, USA), and 'Canaloplasty' MIGS techniques such as the OMNI™ (Sight Sciences, Menlo Park, CA, USA) and iTrack Advance™ (Nova Eye, Lakes Creek, Queensland, Australia) systems. These techniques have become more popular, particularly in patients who need a reduction in medication burden and also to potentially avoid some of the postoperative complications attributed to conventional glaucoma filtration surgery [8,9]. Additionally, and particularly in Europe, non-penetrating glaucoma surgeries (NPGS), such as deep sclerectomy and canaloplasty, have been developed to provide safer yet still effective ways of reducing intraocular pressure (IOP) in patients with more advanced glaucoma where target eye pressures are significantly lower [10–12]. The use of these procedures is increasing significantly compared to conventional trabeculectomy due to the drawbacks of risk of hypotony, intensive post-operative management, the need for proper training, and a significant learning curve. Finally, a further group of glaucoma surgeries, in the form of glaucoma drainage devices (GDDs) or 'tubes', have been around for a while as options for complex disease, including secondary glaucoma due to neovascularization and uveitis, congenital and juvenile glaucoma, aphakic glaucoma, etc. [13–15]. Although not that new in concept, new GDDs have been developed over the last few years, offering different lumen sizes and plate designs, which can further alter the outcomes we expect from these devices [16–18].

Advances in glaucoma surgery have therefore been happening for over the last five decades. However, there has never been such an exciting time to work in the field of glaucoma surgical therapy as the spectrum of options available has become so wide, dense, and varied. Big Pharma is acquiring more and more start-ups that have developed, tried, and tested their products with ever-increasing amounts of evidence building over the last few years. This trend will only increase the drive to seek the best devices and to utilize them to their best capacity in individualized ways. Ultimately, this can only benefit the patient, as long as sound evidence, real-life experience, and cost-effectiveness are also available and considered simultaneously. The evolution of older surgeries such as more modern and innovative ways of performing trabeculectomy and NPGS, and the dissemination of more recent techniques and devices, including their use beyond the original indications for which they were developed, can only boost our chances of effectively lowering IOP and reducing glaucoma visual disability for our patients. We truly hope that this Special Issue, entitled "Advances in Glaucoma Surgery", can truly capture the essence of these new, exciting, and creative ways of enhancing the effectiveness and safety of our glaucoma surgical armamentarium.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Tham, Y.C.; Li, X.; Wong, T.Y.; Quigley, H.A.; Aung, T.; Cheng, C.Y. Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis. *Ophthalmology* **2014**, *121*, 2081–2090. [CrossRef] [PubMed]
2. Musch, D.C.; Gillespie, B.W.; Lichter, P.R.; Niziol, L.M.; Janz, N.K.; Investigators, C.S. Visual field progression in the Collaborative Initial Glaucoma Treatment Study the impact of treatment and other baseline factors. *Ophthalmology* **2009**, *116*, 200–207. [CrossRef] [PubMed]
3. Mansouri, K.; Medeiros, F.A.; Weinreb, R.N. Global rates of glaucoma surgery. *Graefes Arch. Clin. Exp. Ophthalmol.* **2013**, *251*, 2609–2615. [CrossRef] [PubMed]
4. Edmunds, B.; Thompson, J.R.; Salmon, J.F.; Wormald, R.P. The National Survey of Trabeculectomy III: Early and late complications. *Eye* **2002**, *16*, 297–303. [CrossRef] [PubMed]
5. Saheb, H.; Ahmed, I.I. Micro-invasive glaucoma surgery: Current perspectives and future directions. *Curr. Opin. Ophthalmol.* **2012**, *23*, 96–104. [CrossRef] [PubMed]
6. Nichani, P.; Popovic, M.M.; Schlenker, M.B.; Park, J.; Ahmed, I.I.K. Microinvasive glaucoma surgery: A review of 3476 eyes. *Surv. Ophthalmol.* **2021**, *66*, 714–742. [CrossRef] [PubMed]
7. SooHoo, J.R.; Seibold, L.K.; Radcliffe, N.; Kahook, M.Y. Minimally invasive glaucoma surgery: Current implants and future innovations. *Can. J. Ophthalmol.* **2014**, *49*, 528–533. [CrossRef] [PubMed]
8. Chen, D.Z.; Sng, C.C.A. Safety and Efficacy of Microinvasive Glaucoma Surgery. *J. Ophthalmol.* **2017**, *2017*, 3182935. [CrossRef] [PubMed]
9. Conlon, R.; Saheb, H.; Ahmed, I.I. Glaucoma treatment trends: A review. *Can. J. Ophthalmol.* **2017**, *52*, 114–124. [CrossRef] [PubMed]
10. Fyodorov, S.N. Nonpenetrating deep sclerectomy in open angle glaucoma. *Ophthalmosurgery* **1989**, *3*, 52–55.
11. Mendrinos, E.; Mermoud, A.; Shaarawy, T. Nonpenetrating glaucoma surgery. *Surv. Ophthalmol.* **2008**, *53*, 592–630. [CrossRef] [PubMed]
12. Rabiolo, A.; Leadbetter, D.; Alaghband, P.; Anand, N. Primary Deep Sclerectomy in Open-Angle Glaucoma: Long-Term Outcomes and Risk Factors for Failure. *Ophthalmol. Glaucoma* **2021**, *4*, 149–161. [CrossRef] [PubMed]
13. Aref, A.A.; Gedde, S.J.; Budenz, D.L. Glaucoma Drainage Implant Surgery. *Dev. Ophthalmol.* **2017**, *59*, 43–52. [PubMed]
14. Christakis, P.G.; Kalenak, J.W.; Tsai, J.C.; Zurakowski, D.; Kammer, J.A.; Harasymowycz, P.J.; Mura, J.J.; Cantor, L.B.; Ahmed, I.I.K. The Ahmed Versus Baerveldt Study: Five-Year Treatment Outcomes. *Ophthalmology* **2016**, *123*, 2093–2102. [CrossRef] [PubMed]
15. Rockwood, E.J. The Ahmed Baerveldt Comparison (ABC) Study: Long-Term Results, Successes, Failures, and Complications. *Am. J. Ophthalmol.* **2016**, *163*, xii–xiv. [CrossRef] [PubMed]
16. Koh, V.; Chew, P.; Triolo, G.; Lim, K.S.; Barton, K. Treatment Outcomes Using the PAUL Glaucoma Implant to Control Intraocular Pressure in Eyes with Refractory Glaucoma. *Ophthalmol. Glaucoma* **2020**, *3*, 350–359. [CrossRef] [PubMed]
17. Vallabh, N.A.; Mason, F.; Yu, J.T.S.; Yau, K.; Fenerty, C.H.; Mercieca, K.; Spencer, A.F.; Au, L. Surgical technique, perioperative management and early outcome data of the PAUL® glaucoma drainage device. *Eye* **2022**, *36*, 1905–1910.
18. Roy, S.; Villamarin, A.; Stergiopulos, C.; Bigler, S.; Guidotti, J.; Stergiopulos, N.; Kniestedt, C.; Mermoud, A.J. Initial Clinical Results of the eyeWatch: A New Adjustable Glaucoma Drainage Device Used in Refractory Glaucoma Surgery. *J. Glaucoma* **2019**, *28*, 452–458. [CrossRef] [PubMed]