

# Minimally Invasive Glaucoma Surgery

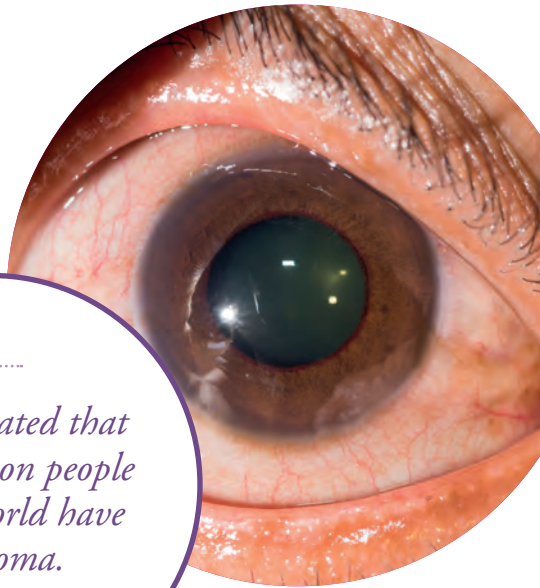
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## INTRODUCTION

*Glaucoma is defined as a group of conditions where eye pressure related damage to the optic nerve occurs and remains the leading cause of irreversible blindness worldwide.*

It is estimated that 64.3 million people (3.54% of the world's population) have glaucoma. Irrespective of the type of glaucoma, at present, the only proven treatment is to lower/stabilise the intra-ocular pressure (IOP) with the aim of reducing the rate of deterioration and preventing additional glaucomatous optic nerve damage.

Conventional treatment involves the initial control of intra-ocular pressure with topical medication, of which there are many options available now on the market. Depending on the type of glaucoma and the amount of IOP lowering required, Selective Laser Trabeculoplasty (SLT) can also be a useful treatment in the initial stages. Apart from requiring further IOP reduction, other major issues such as patient adherence and ocular toxicity, expedite the need for glaucoma surgery.



*It is estimated that 64.3 million people in the world have glaucoma.*

## CONVENTIONAL GLAUCOMA SURGERY

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There are essentially two well established glaucoma procedures which are widely practiced and are effective in reducing the intra-ocular pressure. These are trabeculectomy and aqueous tube shunt. Whilst originally described in the 1960's, both techniques have undergone various modifications in an attempt to improve their efficacy as well as safety profile. A recent head to head Trial, (tube vs. Trabeculectomy, TVT), the average IOP 5 years after surgery was 14.4 mmHg in the tube group and 12.6 mmHg in the trabeculectomy group.

The rate of re-operation was 9% in the tube group and 29% in the trabeculectomy group at 5 years. Even though effective, these incisional surgeries can result in failure due to scarring, have an impact on the patients' quality of life due to bleb-related foreign body sensation, induced astigmatism, and secondary cataracts, as well as having potentially vision-threatening complications such as blebitis, endophthalmitis, or choroidal hemorrhage.

Given all these factors, glaucoma surgery is often reserved for later stages of the condition, which until recently has resulted in a gap in the treatment continuum in moderately progressive disease.

## MINIMALLY INVASIVE GLAUCOMA SURGERY (MIGS)

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MIGS is an umbrella term used to describe a group of newer/emerging surgical techniques with several common defining features outlined herewith. The first is an Ab interno glaucoma surgery, i.e. conjunctival sparing, through a clear corneal incision which minimises significant scarring, allowing future uncomplicated conjunctival surgery if required.

A second feature is that these procedures are minimally traumatic and therefore the devices used are associated with negligible disruption of normal anatomy and physiology. The third feature is an excellent safety profile compared to traditional glaucoma surgeries. These surgeries usually avoid serious complications seen with other glaucoma surgeries, e.g. bleb related endophthalmitis, diplopia etc. The fourth feature is that given the nature of the techniques, there is often a rapid recovery causing minimal impact on the patient's quality of life.

Given the definition above, MIGS procedure can essentially be divided into three anatomical categories. These are: Schlemm's canal procedures (improving trabecular outflow), the suprachoroidal space procedures (improving the uveoscleral outflow) and the subconjunctival space procedures (creating an alternative outflow pathway for aqueous humor). Whilst a detailed discussion on the individual devices is beyond the scope of this article, a brief mention of the available/emerging devices will be made here.

## SCHLEMM'S CANAL DEVICES/PROCEDURES

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There are currently five MIGS procedures available in humans that target the juxtacanalicular portion of the trabecular meshwork. These are the Trabectome, iStent (a heparin-coated, non-ferromagnetic, titanium stent, approximately 1x0.3 mm in size), Hydrus (Ivantis, Inc, Irvine, CA, USA) an 8 mm-long, nitinol, crescent-shaped open structure, curved to match the shape of Schlemm's canal, Gonioscopy-Assisted Transluminal Trabeculotomy (GATT), and Excimer Laser Trabeculotomy (ELT). These procedures are based on the concept that the juxtacanalicular system is the site of greatest resistance of aqueous outflow in most open-angle glaucoma (OAG) patients.



## SUPRACHOROIDAL SPACE DEVICES/PROCEDURES

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There are currently two devices under investigation in this category, these are the The Cypass (Transcend Medical, Menlo Park, CA, USA) a polyamide implant, 6.35 mm in length and 510µm in external diameter, and the iStent supra (Glaukos Corporation, Laguna Hills, CA, USA). Given that Uveoscleral outflow is thought to account for up to 50% of aqueous drainage in normal human eyes, the concept is promising but the efficacy of these devices is yet to be determined.

## SUBCONJUNCTIVAL SPACE DEVICES/PROCEDURES

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This method, which creates a non-physiologic route for aqueous outflow, is the basis of the traditional trabeculectomy and aqueous shunt glaucoma surgeries. The only current commercially available implant for Ab interno implantation is the XEN gel stent (Figure 1), 6 mm in length and composed of porcine gelatin cross-linked with glutaraldehyde, which is implanted via a clear corneal incision either combined with cataract surgery or as a single procedure without conjunctival dissection.

## CONCLUDING REMARKS

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Glaucoma surgery has undergone an exciting revolution in the last decade. The introduction of MIGS has filled in a void that has long existed in the continuum of glaucoma management. Most of the devices are currently undergoing trials but on the whole, it appears that the efficacy of most of these procedures is often modest compared to more invasive glaucoma surgeries such as trabeculectomy with Mitomycin C or glaucoma drainage devices. It is important to point out though, this compromise in efficacy is balanced by a safer risk profile.



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Legends: Figure 1. BAERVELDT® BG 103-250  
Glaucoma Implant vs. XEN gel implant (Arrow)