GLAUCOMA SURGICAL TREATMENTS

Policy Number: 2019T0443W  Effective Date: April 1, 2019

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COVERAGE RATIONALE

The following are proven and medically necessary:

- Glaucoma drainage devices for treating refractory glaucoma when medical or surgical treatments have failed or are inappropriate
- iStent® Trabecular Micro-Bypass Stent System for treating mild to moderate open-angle glaucoma when used in combination with cataract surgery
- Canaloplasty for treating primary open-angle glaucoma

The following are unproven and not medically necessary for treating any type of glaucoma due to insufficient evidence of efficacy and/or safety:

- CyPass® Micro-Stent System
- Xen® Glaucoma Treatment System
- Hydrus® Microstent
- Glaucoma drainage devices that are not FDA approved
- Viscocanalostomy

APPLICABLE CODES

The following list(s) of procedure and/or diagnosis codes is provided for reference purposes only and may not be all inclusive. Listing of a code in this policy does not imply that the service described by the code is a covered or non-covered health service. Benefit coverage for health services is determined by the member specific benefit plan document and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claim payment. Other Policies and Coverage Determination Guidelines may apply.

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<th>CPT Code</th>
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<tr>
<td>0191T</td>
<td>Insertion of anterior segment aqueous drainage device, without extraocular reservoir, internal approach, into the trabecular meshwork; initial insertion</td>
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<tr>
<td>0253T</td>
<td>Insertion of anterior segment aqueous drainage device, without extraocular reservoir, internal approach, into the suprachoroidal space</td>
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<tr>
<td>0376T</td>
<td>Insertion of anterior segment aqueous drainage device, without extraocular reservoir, internal approach, into the trabecular meshwork; each additional device insertion (List separately in addition to code for primary procedure)</td>
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<tr>
<td>0449T</td>
<td>Insertion of aqueous drainage device, without extraocular reservoir, internal approach, into the subconjunctival space; initial device</td>
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<tr>
<td>0450T</td>
<td>Insertion of aqueous drainage device, without extraocular reservoir, internal approach, into the subconjunctival space; each additional device (List separately in addition to code for primary procedure)</td>
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### CPT Code

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<tr>
<td>0474T</td>
<td>Insertion of anterior segment aqueous drainage device, with creation of intraocular reservoir, internal approach, into the supraciliary space</td>
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<tr>
<td>66170</td>
<td>Fistulization of sclera for glaucoma; trabeculectomy ab externo in absence of previous surgery</td>
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<tr>
<td>66174</td>
<td>Transluminal dilation of aqueous outflow canal; without retention of device or stent</td>
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<tr>
<td>66175</td>
<td>Transluminal dilation of aqueous outflow canal; with retention of device or stent</td>
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<td>66184</td>
<td>Revision of aqueous shunt to extraocular equatorial plate reservoir; without graft</td>
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*CPT® is a registered trademark of the American Medical Association*

### HCPCS Code

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<tr>
<td>L8612</td>
<td>Aqueous shunt</td>
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### DESCRIPTION OF SERVICES

Glaucoma refers to a group of eye diseases in which vision is lost due to damage of the optic nerve. The 2015 American Academy of Ophthalmology (AAO) Preferred Practice Patterns Guidelines report on primary open-angle glaucoma (POAG) states that the severity of glaucoma damage can be estimated using the following:

- **Mild:** Optic nerve abnormalities consistent with glaucoma and a normal visual field as tested with standard automated perimetry (SAP)
- **Moderate:** Optic nerve abnormalities consistent with glaucoma and visual field abnormalities in one hemifield that are not within 5 degrees of fixation as tested with SAP
- **Severe:** Optic nerve abnormalities consistent with glaucoma and visual field abnormalities in both hemifields and/or loss within 5 degrees of fixation in at least one hemifield as tested with SAP
- **Indeterminate:** Optic nerve abnormalities consistent with glaucoma, inability to perform visual field testing, unreliable/uninterpretable visual field test results, or visual fields not yet performed

Trabeculectomy is a surgical procedure that removes part of the eye’s trabecular meshwork and adjacent structures to reduce intraocular pressure (IOP) in individuals with glaucoma. For the majority of individuals, it is the most common surgery that allows drainage of aqueous humor from within the eye to underneath the conjunctiva where it is absorbed.

Non-penetrating procedures include canaloplasty and viscocanalostomy. The difference between viscocanalostomy and canaloplasty is that the latter aims at opening the entire length of the canal, not just one section of it.

Canaloplasty is a surgical technique for glaucoma which aims to restore the natural drainage of fluid from the eye (National Institute for Health and Care Excellence (NICE), 2008; updated 2017). Canaloplasty involves viscodilation of the Schlemm's canal with an illuminated tipped microcatheter. The microcatheter is used to place an intracanalicular suture that cinches and stretches the trabecular meshwork inwards while permanently opening the Schlemm's canal.

Viscocanalostomy is a procedure used to treat glaucoma that involves surgical incisions and injection of a viscous, elastic material into the eye. The goal of this procedure is to reduce IOP by creating a channel that allows excess fluid to drain from the eye.

Glaucoma drainage devices (also known as aqueous shunts) include the ExPRESS™ Mini Glaucoma Shunt, the Molteno implant, the Baerveldt tube shunt, and the Ahmed glaucoma valve implant. The ExPRESS™ Mini Glaucoma Shunt is a small stainless steel device that is placed beneath the scleral flap into the anterior chamber instead of creating a punch or excisional sclerostomy, thereby bypassing the trabecular meshwork and directing aqueous fluid to form a perilimbal conjunctiva-covered bleb. The Molteno, Baerveldt and Ahmed glaucoma implants consist of a length of flexible plastic tubing that is inserted into anterior or posterior chamber and connect to a plastic or silicone plate with a large surface area that is secured to the posterior sclera between 2 of the extraocular muscles, and covered by conjunctiva. The plate acts as a physical barrier to scarring of the conjunctiva to the sclera providing a large surface area bleb posterior to the limbus.
Glaucoma drainage devices such as iStent® Trabecular Micro-Bypass, Eyepass, or DeepLight SOLX® Gold Shunt (suprachoroidal shunt) divert aqueous fluid from the anterior chamber directly into Schlemm’s canal (Samuelson, 2008). The Xen® Gel Stent is for use in individuals with refractory glaucoma. A gelatin tube is implanted into the subconjunctival space and is proposed as a less traumatic alternative to ab externo procedures such as trabeculectomy and shunt implantation (AqueSys, Inc., 2017). These stenting/shunting procedures are similar to viscocanalostomy in that they lower IOP without the formation of a filtering bleb.

Micro-invasive or minimally invasive glaucoma surgery (MIGS) refers to a group of newer surgical procedures that are performed via an ab interno approach and involve minimal trauma to ocular tissues. Although less effective in lowering IOP than trabeculectomy and aqueous shunt surgery, MIGS appears to have a more favorable safety profile in the short term and is commonly combined with phacoemulsification. Examples of MIGS are the iStent® and the Hydrus® Microstent (AAO, 2015; Hayes, 2018).

**CLINICAL EVIDENCE**

**Canaloplasty**

Rękas et al. (2015) conducted a prospective, randomized trial comparing safety and efficacy of non-penetrating deep sclerectomy (NPDS) using a viscoelastic compound versus canaloplasty in 29 eyes of individuals with uncontrolled POAG and a cataract. Outcomes measured included corrected distance visual acuity, IOP, and number of medications required postoperatively. Complete and qualified success was an IOP ≤ 18 mmHg. Follow-up examinations were performed on days 1 and 7, and at 1, 3, 6, and 12 months. Both groups had similar IOPs preoperatively. At 12 months, there were no statistical differences identified either in IOP or number of medications utilized. Complete and qualified success rates for the canaloplasty and NPDS groups were 79% and 77%, respectively. With these findings, the authors concluded that neither procedure is superior to the other in providing safe and effective treatment to the glaucoma patient with cataracts. However, over 50% of the NPDS group required intervention for AEs occurring in the postoperative period, while the canaloplasty group required no postoperative management.

Matlach et al. conducted a prospective, comparative, randomized controlled trial (RCT) known as the TVC study, where participants received trabeculectomy (n=32) or canaloplasty (n=30) and were followed for 2 years. Primary outcomes included complete success (without medication) and qualified success (with or without medication), defined as IOP of ≤18 mmHg (definition 1) or IOP ≤21 mmHg and ≥20% IOP reduction (definition 2), IOP ≥5 mmHg, no vision loss and no further glaucoma surgery. Each surgical intervention resulted in significantly reduced IOP. Complete success was achieved in 74% and 39% (definition 1), and 68% and 39% (definition 2) at 2 years in the trabeculectomy and canaloplasty groups, respectively. Mean absolute IOP reduction was slightly better at 2 years with trabeculectomy (10.8 ± 6.9 mmHg) versus canaloplasty (9.3 ± 5.7 mmHg). Adverse events (AEs) were more frequent following trabeculectomy. The authors concluded that trabeculectomy is associated with a better reduction in IOP and less need for medication, but has a higher complication rate. If target IOP is attainable by moderate reduction, canaloplasty may be considered for its ease of postoperative care and lack of complications (2015).

Koerber et al. (2012) compared the safety and efficacy of canaloplasty in one eye with viscocanalostomy in the contralateral eye in 15 patients (30 eyes) with bilateral primary open-angle glaucoma (POAG). Sixty percent of patients had the canaloplasty procedure first, followed by the viscocanalostomy procedure. At 18-month follow-up, both procedures canaloplasty and viscocanalostomy were successful in reducing IOP. The percentage reduction in IOP was significantly higher in the canaloplasty eyes (approximately 44%), as compared with the viscocanalostomy eyes (approximately 33%), at both 12 and 18 months. Final absolute IOP was not significantly different, although lower, in the canaloplasty group versus the viscocanalostomy group at 18 months. Using the criteria for complete success defined as an IOP of ≤ 18 mm Hg without antiglaucoma medication, and qualified success as an IOP of ≤ 18 mm Hg with 1 or 2 antiglaucoma medications, the canaloplasty cohort achieved complete success in 60.0% of eyes, and complete or qualified success in 87% of eyes. The viscocanalostomy group achieved complete success in 35.7% of eyes, and complete or qualified success in 36% and 50.0% of eyes, respectively. Complications were minimal in both groups. According to the authors, canaloplasty and viscocanalostomy were safe and effective in the surgical management of OAG. The authors also stated that canaloplasty procedures showed superior efficacy to viscocanalostomy in the reduction of IOP.

Griessler et al. (2010b) compared the safety and efficacy of 2 polypropylene (Prolene) sutures for tensioning of the inner wall of Schlemm’s canal in patients with POAG undergoing canaloplasty. This prospective RCT included 90 patients. The mean preoperative IOP was 42.7 mm Hg in group 1 and 45.0 mm Hg in group 2. The mean postoperative IOP without medications was 18.4 mm Hg in group 1 and 16.4 mm Hg in group 2 at 1 month. Mean IOP at 15 months for group 1 was 19.2 mm Hg and 16.4 mm Hg in group 2. Pressures equal or less than 21, 18, and 16 mm Hg without medications (complete success) at 12 months were 51%, 34%, and 21% in group 1, and 77%, 69%, and 54% in group 2, respectively. The investigators concluded that IOP reduction was substantial in canaloplasty. Younger age, but not the level of IOP at surgery, had a positive effect on the amount of IOP reduction, thus suggesting that an early surgical intervention to re-establish physiological outflow offers the best prognosis.
Griesshaber et al. (2010a) evaluated the safety and effectiveness of 360° visco-dilation and tensioning of Schlemm canal (canaloplasty) in patients with POAG. Sixty randomly selected eyes of 60 consecutive patients with POAG were included in this prospective study. The mean preoperative IOP was 45.0 mm Hg. The mean follow-up time was 30.6 months. The mean IOP at 12 months was 15.4 mm Hg (n=54), 16.3 mm Hg at 24 months (n = 51), and 13.3 mm Hg at 36 months (n=49). For IOP ≤ 21 mm Hg, complete success rate was 77.5% and qualified success rate was 82% at 36 months. Complication rate was low. The investigators conclude that canaloplasty produced a sustained long-term reduction of IOP in patients with POAG independent of preoperative IOP. As a bleb-independent procedure, canaloplasty may be a true alternative to classic filtering surgery, in particular in patients with enhanced wound healing and scar formation.

Lewis et al. (2011) conducted a multicenter clinical trial that included 157 eyes in 157 patients (140 patients with POAG, 17 patients with other glaucoma diagnoses) who underwent canaloplasty or combined cataract-canaloplasty surgery. A total of 121 eyes (77%) had canaloplasty alone, while 36 eyes (23%) with visually significant cataracts had canaloplasty combined with cataract extraction (phacocanaloplasty). Complete success (defined as attaining an IOP of ≤ 18 mm Hg without antiglaucoma medication) at 3-year follow-up was achieved in 36% of eyes receiving canaloplasty alone with successful suture placement, and 70% of eyes having the combined phacocanaloplasty procedure with successful suture placement. Complete or qualified success (defined as attaining an IOP of ≤ 18 mm Hg with 1 or 2 antiglaucoma medications) was achieved in 77.5% of eyes with canaloplasty alone, and 89% of eyes with phacocanaloplasty. The authors concluded that canaloplasty led to a significant and sustained IOP reduction in adult patients with OAG and had an excellent short- and long-term postoperative safety profile.

Bull et al. (2011) reported 3-year results investigating the safety and efficacy of canaloplasty in a prospective, multi-center, interventional study of 109 eyes of 109 adult OAG patients undergoing canaloplasty or combined cataract-canaloplasty surgery. IOP and medication use results for all study eyes were significantly decreased from baseline. According to the authors, canaloplasty demonstrated significant and sustained IOP reductions accompanied by an excellent short- and long-term safety profile in adult patients with OAG.

**Viscocanalostomy**

A Cochrane review analyzed data from RCTs and quasi-RCTs where surgical techniques were utilized to treat primary congenital glaucoma (PCG). The rationale for the analysis was to compare the efficacy and safety of different surgical techniques in children diagnosed at age one and younger and having surgical therapy before 5 years of age (N=61). Due to the limited sample sizes for all trials (average of 10 children per trial), the evidence as to whether a particular surgical technique is effective and which surgical technique is better still remains uncertain. AEs such as choroidal detachment, shallow anterior chamber and hyphema were reported from 4 trials. None of the trials reported quality of life (QOL) or economic data. These trials were neither designed nor reported well overall. Due to poor study design and reporting, the reliability and applicability of evidence remain unclear. The author states that no conclusions could be drawn from the trials included in this review due to paucity of data, stating that more research is needed to determine which of the many surgeries performed for PCG are effective (Ghate et al., 2015).

Another Cochrane review conducted by Eldal et al. included relevant RCTs and quasi-RCTs on participants undergoing standard trabeculectomy for OAG compared to non-penetrating glaucoma surgery (NPGS), specifically viscocanalostomy or deep sclerectomy, with or without adjunctive measures. Included were 5 studies with a total of 311 eyes (participants = 247), of which 133 eyes (133 participants) were quasi-randomized. Eyes having trabeculectomy (n=160) were compared to those having NPGS (deep sclerectomy = 101 eyes, and 50 eyes had viscocanalostomy). The authors concluded that this review provided limited evidence that control of IOP is better with trabeculectomy than viscocanalostomy, although there is uncertainty about trabeculectomy versus deep sclerectomy. AEs appeared more common in the trabeculectomy arm, as cataract was more commonly reported in addition to OAG. However, overall AEs were rare. Study limitations included absence of QOL measurement, poor quality evidence and high risk of bias. Further RCTs are needed (2015).

Chai et al. (2010) conducted a meta-analysis to compare the efficacy and safety profile of viscocanalostomy versus trabeculectomy. Ten RCTs were selected and included in the meta-analysis with a total of 458 eyes of 397 patients with medically uncontrolled glaucoma. Trabeculectomy was found to have a significantly better pressure-lowering outcome. Viscocanalostomy had a significantly higher relative risk of intraoperative perforation of the Descemet membrane, whereas trabeculectomy had significantly more postoperative AEs. The reviewers concluded that trabeculectomy had a greater pressure-lowering effect compared with viscocanalostomy. However, viscocanalostomy had a significantly better risk profile.

A meta-analysis by Hondur et al. (2008) evaluated the efficacy of NPGS for OAG with respect to target IOP and severity of glaucoma. The studies reviewed included deep sclerectomy and viscocanalostomy. With lower set IOP targets, the rates of success varied between 35% and 86% for deep sclerectomy, and between 10% and 67% for viscocanalostomy. Mean follow-up was mostly in the range of 3 years. The authors concluded that NPGS seems to
provide IOP reduction into the high teens. Its potential to achieve lower target IOPs seems to be low. Longer-term studies with data related to glaucoma severity and proper target IOPs are required.

Cheng et al. (2011) evaluated the IOP-lowering effects achieved by NPGS in patients with OAG in a systematic review of RCTs. The pooled estimates were calculated using the random effects model. Both deep sclerectomy and viscocanalostomy were less effective than trabeculectomy in lowering IOP, with the percentage IOP reductions at 2 years being 35%, 30%, and 46% for deep sclerectomy, viscocanalostomy, and trabeculectomy, respectively. The complete success rates at 4 years were 35% for deep sclerectomy, and 23% for viscocanalostomy, both lower than that of trabeculectomy (48%). According to the authors, primary deep sclerectomy and primary viscocanalostomy were associated with fewer complications than trabeculectomy. However, trabeculectomy was superior to NPGS in reduction of IOP and overall success.

In a guidance on the diagnosis and management of chronic OAG and ocular hypertension, NICE concluded from the evidence (low to moderate quality) that trabeculectomy is more effective than non-penetrating surgery (e.g., viscocanalostomy) in reducing IOP from baseline at 6- and 12-month follow-ups, but the effect size may be too small to be clinically significant. Trabeculectomy is also more effective in reducing the number of eyes with unacceptable IOP at 6- and 12-months (2009, updated 2017).

**Glaucoma Drainage Devices Approved by the U.S. Food and Drug Administration (FDA)**

**EX-PRESS™**

A 2017 Hayes report of published literature on the use of the EX-PRESS™ Glaucoma Filtration Device (EGFD) for the treatment of IOP in patients with OAG yielded 7 RCTs reported in 10 publications with participants ranging from 15-120 patients. They concluded that a moderate-quality body of evidence suggested that use of the EX-PRESS™ device results in similar outcomes when compared with trabeculectomy (the current standard of care), citing few differences between the 2 procedures relative to reduction of IOP, medication use, and the return of visual acuity in both the short and long term (up to 5 years).

de Jong (2009) conducted a prospective RCT of 78 patients (80 eyes) with primary open-angle, pseudoxfoliative, or pigmentary glaucoma to compare the EX-PRESS™ mini glaucoma shunt with trabeculectomy. A total of 84.6% of patients receiving EX-PRESS™ and 60% of patients receiving trabeculectomy achieved complete success (defined as an IOP of \(<4\) mmHg \(\leq 18\) mmHg without the use of antiglaucoma medications). The respective proportions of patients achieving an IOP \(<4\) mmHg and \(\leq 15\) mmHg were 76.9% and 50.0%. At 1-year follow-up, complete success rates were 81.8% for EX-PRESS™ and 47.5% for trabeculectomy. The authors concluded that the EX-PRESS™ mini glaucoma shunt implanted under a superficial scleral flap produces significantly higher success rates compared with trabeculectomy.

In follow up to the above study de Jong et al. (2011) reported on outcomes at 4 years, beyond those in the original RCT (i.e., up to 5 years in the patients who received either the EX-PRESS™ device \([n=39]\) or who underwent trabeculectomy \([n=39]\)). Compared with trabeculectomy, the EX-PRESS™ device controlled IOP more effectively without medication in a higher percentage of patients from year 1 (86.8% versus 61.5%) to year 3 (66.7% versus 41.0%) post-treatment. At 1 year post-treatment, only 12.8% of patients required IOP medication after EX-PRESS™ implantation, compared with 35.9% after trabeculectomy; however, the proportions became closer each year and at 5 years were 41% versus 53.9%, respectively. Up to the end of the third year after surgery, IOP remained better controlled by EX-PRESS™ devices than by trabeculectomy. In the fourth and fifth years, the differences in IOP control between the 2 groups were not significant.

Ates et al. (2010) evaluated IOP control and graft survival after EX-PRESS™ mini glaucoma shunt implantation in 15 patients. IOP decreased from 41.46 mm Hg to 12.06 mm Hg over a mean follow-up of 12.2 months. Neither biomicroscopy nor pachymetry showed worsening of preoperatively opaque grafts. The investigators concluded that the EX-PRESS™ mini glaucoma shunt implantation may be an effective procedure for refractory post-penetrating keratoplasty glaucoma with acceptable graft failure rates in short term.

**Molteno Implant, Baerveldt Tube Shunt and Ahmed Glaucoma Valve Implant**

Budenz et al. (2011) evaluated the relative efficacy and complications of the Ahmed glaucoma valve (AGV) (New World Medical, Rancho Cucamonga, CA) and the Baerveldt glaucoma implant (BGI) (Abbott Medical Optics, Abbott Park, IL) in refractory glaucoma in a multicenter, RCT. The study included 276 patients (143=AGV group and 133=BGI). Preoperative IOP was 31.2±11.2 mmHg in the AGV group and 31.8±12.5 mmHg in the BGI group. At 1 year, mean±SD IOP was 15.4±5.5 mmHg in the AGV group and 13.2±6.8 mmHg in the BGI group. The mean±SD number of glaucoma medications was 1.8±1.3 in the AGV group and 1.5±1.4 in the BGI group. The cumulative probability of failure in the AGV and BGI groups at 1 year were 16.4% and 14%, respectively. More patients experienced early postoperative complications in the BGI group (58%) compared to 43% in the AGV group. Serious postoperative complications also were more frequent in the BGI group than in the AGV group, at 34% versus 20%, respectively. The investigators concluded that although the average IOP after 1 year was slightly higher in patients...
who received an AGV, there were fewer early and serious postoperative complications associated with the use of the AGV than the BGI.

A Cochrane review compared various aqueous shunts for IOP control and safety (Minkler, 2006). Only RCTs and quasi-RCTs were included. This included 15 trials with a total of 1153 participants with mixed diagnoses. Five studies reported details sufficient to verify the method of randomization but only 2 had adequate allocation concealment. Data collection and follow-up times were variable. Meta-analysis of 2 trials comparing Ahmed implant with trabeculectomy found trabeculectomy resulted in lower mean IOPs 11 to 13 months later. One study concluded there were outcome advantages with a double versus a single-plate Molteno implant and one trial comparing the 350 mm2 and 500 mm2. Baerveldt shunts found no clinically significant advantage of the larger device, but neither of these trials included all patients randomized. One study comparing endocyclophotocoagulation (ECP) with Ahmed implant in complicated glaucomas found no evidence of better IOP control between the 2 treatments. The authors concluded that there are relatively few randomized trials that have been published on aqueous shunts, therefore methodology and data quality among them is poor. To date there is no evidence of superiority of one shunt over another. This meta-analysis was a review of comparative studies and did not evaluated whether aqueous shunts could lower IOP.

Gedde et al. (2009) evaluated the use of the Baerveldt glaucoma implant or trabeculectomy with mitomycin C in a multicenter RCT (known as the Tube versus Trabeculectomy (TVT) Study). A total of 212 eyes of 212 patients with uncontrolled glaucoma were enrolled (tube group =107, and 105 in the trabeculectomy group). At 3 years, IOP was 13.0 mm Hg in the tube group and 13.3 mm Hg in the trabeculectomy group. The number of glaucoma medications in the tube group versus trabeculectomy was 1.3 and 1.0, respectively. The cumulative probability of failure during the first 3 years of follow-up was 15.1% in the tube group and 30.7% in the trabeculectomy group. Postoperative complications developed in 39% and 60% in the tube and trabeculectomy groups, respectively. The investigators concluded that while tube shunt surgery had a higher success rate compared to trabeculectomy during the first 3 years of follow-up, both procedures were nearly equal with regard to IOP reduction and use of supplemental medication therapy at 3 years. While the incidence of postoperative complications was higher following trabeculectomy with MMC relative to tube shunt surgery, most complications were transient and self-limited.

**iStent®**

Arriola-Villalobos et al. (2013) conducted a prospective, non-comparative, uncontrolled, interventional case study to evaluate the mid-term efficacy and safety of the GTS-400- iStent® (Glaukos Corporation, Laguna Hills, CA) combined with phacoemulsification in patients with cataract and open glaucoma (OAG) or ocular hypertension. Subjects underwent phacoemulsification and 2 GTS-400 implantsations. Efficacy outcomes measured included IOP and antiglaucoma medications. Safety outcomes included complications, best-corrected visual acuity and endothelial cell count (ECC). Follow-up was 1 year. 20 patients were enrolled, mean medicated baseline IOP was 19.95 ± 3.71 mm Hg and 26 ± 3.11 mm Hg without medication. Mean final IOP was 16.75 ± 2.24, determining a final IOP decrease of 35.68% from baseline washout IOP. Mean number of medications fell from 1.3 ± 0.66 to 0.3 ± 0.57. 75% of patients were off medications at 1 year. Mean ECC decreased from 2289.64 ± 393.5 cells/mm(2) to 1986.95 ± 520.58 cells/mm(2). The authors concluded that combined cataract surgery with implantation of GTS-400-iStent® appeared to be safe and effective.

Arriola-Villalobos et al. (2012) also evaluated the long-term efficacy and safety of combined cataract surgery and Glaukos iStent® implantation for coexistent OAG and cataract. This prospective case series included 19 patients. Mean follow-up was 53.68 months. Mean IOP was reduced from 19.42 mm Hg at the end of follow up to 16.26 mm, representing a 16.33% decrease. The mean number of pressure-lowering medications used by the patients fell from 1.32 to 0.84. In 42% of patients, no antiglaucoma medications were used at the end of follow-up. Mean best-corrected visual acuity significantly improved from 0.29 to 0.62. The authors concluded that combined cataract surgery and iStent® implantation seems to be an effective and safe procedure to treat coexistent OAG and cataract.

Samuelson et al. (2011) assessed the safety and efficacy of the iStent® trabecular micro-bypass stent in combination with cataract surgery in a prospective, open-label, multicenter randomized controlled trial (RCT). A total of 240 eyes with mild to moderate OAG with IOP ≤24 mmHg controlled on 1 to 3 medications were randomized to undergo cataract surgery with iStent® implantation (treatment group) or cataract surgery only (control). Fifty additional patients were enrolled to undergo cataract surgery with iStent® implantation under protocol expansion. The primary efficacy measure was unmedicated IOP ≤21 mmHg at 1 year. The study met the primary outcome, with 72% of treatment eyes versus 50% of control eyes achieving the criterion. At 1 year, IOP in both treatment groups was significantly lower from baseline values. Thirty-six percent of treatment eyes versus 48% of control eyes achieved 20% or more IOP reduction without medication. The overall incidence of adverse events (AEs) was similar between groups with no unanticipated adverse device effects. The investigators concluded that pressure reduction on fewer medications was clinically and statistically better 1 year after iStent® plus cataract surgery versus cataract surgery alone, with an overall safety profile similar to that of cataract surgery alone.
In a prospective case series, Belovay et al. (2012) evaluated the efficacy and safety of multiple trabecular micro-bypass stents in 47 cataract patients (53 eyes) to treat POAG. Either 2 (n=26) or 3 (n=23) stents were implanted along with concurrent cataract surgery. Efficacy measures were IOP and topical ocular hypertensive medication use. Patients were followed for 1 year. The overall mean 1-year postoperative IOP was 14.3 mm Hg, which was significantly lower than preoperative IOP overall and in each group. The target IOP was achieved in a significantly higher proportion of eyes at 1 year versus preoperatively (77% versus 43%). Overall, 83% of eyes had a decrease in topical ocular hypertensive medication at 1 year from preoperatively, with a 74% decrease in the mean number of medications (from 2.7 to 0.7) at 1 year. The 3-stent group was on significantly fewer medications than the 2-stent group at 1 year. The authors concluded that the use of multiple micro-bypass stents with concurrent cataract surgery led to a mean postoperative IOP of less than 15 mm Hg and allowed patients to achieve target pressure control with significantly fewer medications through 1 year.

An interventional procedure guidance published by NICE concluded that after systematic review and meta-analysis of multiple clinical studies on almost 3100 participants, current evidence demonstrates that trabecular stent bypass microsurgery for OAG is safe and effective (2017).

After examination of 1 systematic review, 6 controlled trials, and 6 case series reporting on more than 3,000 patients, a 2017 ECRI report concluded that the iStent® system implanted during cataract surgery reduces both IOP and postoperative glaucoma medication use. Results are reported as sustained for 1-4 years and AEs have been reported in no more than 12% of study participants. Additional long-term comparative data and more data on vision loss are needed.

A Hayes report concluded that the iStent® device, when used in combination with cataract surgery, appears to be an efficacious and safe treatment for patients with OAG who do not achieve adequate control of IOP on ocular hypertensive medications, although its effectiveness compared with other minimally invasive surgical procedures is not established (2018).

Several registered ongoing clinical trials relevant to the iStent® are in progress, including 2 large trials (n=860) assessing 3 to 5-year outcomes with the device. For more information, please go to www.clinicaltrials.gov. (Accessed November 6, 2018)

CyPass®

In August 2018, the manufacturer of the CyPass® Micro-Stent voluntarily withdrew the device from the global market and surgeons were advised to immediately cease further use. The FDA classifies this as a Class I recall, representing “a situation where there is a reasonable chance that the product will cause serious health problems”. They will review new information as it becomes available.

A 2017 Hayes search of published peer reviewed literature on the use of the CyPass® Micro-Stent (Alcon, Fort Worth, TX) identified 5 abstracts (1 RCT (the COMPASS trial), 1 prospective uncontrolled study, and 3 uncontrolled postmarket registry studies) with a combined total of 825 participants. It was concluded that there is insufficient published evidence to assess the safety and/or impact on health outcomes or patient management of the CyPass® Micro-Stent for the treatment of glaucoma in adults.

A 2017 ECRI review of peer-reviewed literature assessing the CyPass® cites the COMPASS RCT as well as 2 case series (total participants=729) published between January 1, 2012 and May 11, 2017. The reviewers concluded that the evidence appears favorable relating to the use of the CyPass® implantation system during cataract surgery, and that both long term and more comparative data are needed.

In a multicenter interventional RCT, Vold et al. evaluated 2-year safety and efficacy of supraciliary microstenting (CyPass®) for treating mild-to-moderate POAG in patients undergoing cataract surgery. Subjects had POAG with mean diurnal unmedicated IOP of 21–33 mmHg and were undergoing phacoemulsification cataract surgery. Of 505 subjects, 131 were randomized to the control group and 374 to the microstent group. There was early and sustained IOP reduction, with 60% of controls versus 77% of microstent subjects achieving ≥20% unmedicated IOP lowering versus baseline at 24 months. Mean 24-month medication use was 67% lower in microstent subjects; 59% of control versus 85% of microstent subjects were medication free. No vision-threatening microstent-related AEs occurred. Visual acuity was high in both groups through 24 months; >98% of all subjects achieved 20/40 best-corrected visual acuity or better. The authors concluded that microinterventional surgical treatment for mild-to-moderate POAG was safe, and the technology’s use resulted in a sustained 2-year reduction in IOP and glaucoma medication use (2016).

A multicenter, single-arm interventional study known as the DUETTE study was conducted by García-Feijoo et al. to evaluate the safety and efficacy of a supraciliary micro-stent (CyPass®) for surgical treatment of glaucoma in patients refractory to topical medications. Patients with OAG (Shaffer Grade 3 and 4) and uncontrolled medicated IOP >21 mm Hg at baseline and candidates for conventional glaucoma surgery were enrolled. CyPass® Micro-Stent implantation
was completed in all patients using a standard clear corneal approach. AEs, postoperative IOP changes, and need for IOP-lowering medications during the first 12 postoperative months (12M) were monitored. Sixty-five eyes were enrolled, and 55 were available at 12M. There were no serious intraoperative events or major AEs. At 12M, mean IOP was reduced by 34.7% and mean medication usage also decreased. In eyes originally indicated for conventional glaucoma surgery, no secondary surgery was performed in 83% (53/64). The authors concluded that supraciliary stenting with the CyPass® effectively lowers IOP as a surgical treatment for glaucoma, precluding the need for more invasive glaucoma surgery in >80% of patients at 1 year, thereby reducing postoperative glaucoma surgical complications (2015).

There are 4 clinical trials either active, recruiting, or enrolling by invitation relating to the CyPass® Micro-Stent implantation system. For more information, please go to www.clinicaltrials.gov. (Accessed November 6, 2018)

**XEN® Glaucoma Treatment System**

Schlenker et al. (2017) conducted an investigator-initiated, international, multicenter, retrospective cohort study of consecutive patients who underwent either standalone microstent insertion with mitomycin C (MMC) or trabeculectomy with MMC. A total of 354 eyes of 293 patients (185 microstent and 169 trabeculectomy) participated in the study that extended between January 1, 2011, and July 31, 2015. Eligibility criteria included patients with multiple types of glaucoma and above-target IOP on maximum medical therapy. Participants were between the ages of 30-90 years with no history of previous incisional surgery for their eye disease. The authors concluded that there was no detectable difference in risk of failure and safety between standalone microstent with MMC and trabeculectomy with MMC. However, further research was believed to be warranted to further investigate these procedures.

Grover et al. evaluated the performance and safety of the XEN® 45 Gel Stent (Allergan, Irvine, CA) for the treatment of refractory glaucoma in a prospective, single-arm, open-label, multicenter clinical study sponsored by the manufacturer. Selection criteria included individuals with refractory glaucoma, defined as prior failure of a filtering or cilioablativd procedure and/or uncontrolled IOP on maximally tolerated medical therapy. A total of 65 eyes in patients 45 years of age and older were implanted. No intraoperative complications or unexpected postoperative AEs were reported. During the 1 year of follow up, most AEs were considered mild/moderate and resolved with no sequelae. The authors concluded that the XEN® 45 Gel Stent safely reduced both IOP and medication use and offer a less invasive surgical option for this subset of patients. Potential study limitations include the absence of comparator and open-label study design, which could have impacted the outcomes (2017).

De Gregorio et al. (2017) conducted a nonrandomized prospective clinical study to assess safety and efficacy of the XEN® 45 Gel Stent when combined with microincisional cataract surgery (MICS). Forty-one eyes of 33 patients with OAG underwent the combination surgery, and there were no major intra- or postoperative complications noted. Complete success was achieved in 80.4% and a qualified success reported in 97.5% after 12 months of follow-up. The authors concluded that the XEN® 45 gel implant is statistically effective in reducing IOP and medication use with minimal complications in glaucoma patients.

In 2018, De Gregorio and colleagues provided a review of the currently published clinical data to assess the potential role of XEN gel stent, the only filtering MIGS device that allows the subconjunctival filtration, in the management of glaucoma. Citing the findings of Galal (2017), Schlenker (2017), Grover (2017), Pérez-Torregrosa (2016) and others, the authors concluded that XEN gel stent is a safe and effective MIGS for controlling IOP in early, moderate, advanced, or refractory glaucoma patients, offering ophthalmologists a new tool to reach the target IOP as a final step in refractory glaucoma, as well as an early surgical treatment for patients intolerant to medical therapy.

A review of published literature by Kerr et al. (2017) concluded that a growing body of evidence suggests that primary MIGS (including but not limited to the XEN® Glaucoma Treatment System) may be a viable initial treatment option to non-surgical intervention. However, further investigator-initiated randomized trials of sufficient size and duration are necessary to better evaluate efficacy.

Vinod and Gedde (2017) reviewed published literature from 2015 through 2016, commenting that findings are notable regarding new and emerging glaucoma procedures. While the data on newer techniques (including but not limited to the XEN® Gel Stent) are promising, the opinion of the authors was that further studies by means of RCTs with extended follow-up periods continue to be necessary to better evaluate long-term efficacy.

In a prospective interventional study, 13 eyes with POAG underwent XEN implantation with subconjunctival mitomycin-C. Of those eyes, 3 were pseudophakic and 10 underwent simultaneous phacoemulsification and XEN. Patients had uncontrolled IOP, intolerance to therapy, or maximal therapy but undergoing cataract extraction. One year of follow-up documentation of IOP, number of medications, visual acuity, and complications. Complete success was defined as IOP reduction ≥ 20% from preoperative baseline at 1 year without any glaucoma medications, while partial success as IOP reduction of ≥ 20% with medications. Results reflected a drop in IOP from 16 ± 4 mmHg pre-op to 9 ± 5, 11 ± 6, 12 ± 5, 12 ± 4, and 12 ± 3 mmHg at 1 week, 1, 3, 6, and 12 months, respectively. At 1 year, best
corrected visual acuity (BCVA) improved from 0.33 ± 0.34 to 0.13 ± 0.11; and mean number of medications decreased from 1.9 ± 1 preoperatively to 0.3 ± 0.49. 42% of eyes achieved complete success and 66% qualified success. Complications included choroidal detachment in 2 eyes, implant extrusion in 1 eye, and 2 eyes underwent trabeculectomy. The authors concluded that the XEN implant is an effective surgical treatment for POAG, with significant reduction in IOP and glaucoma medications at 1 year, and state that longer follow-up is needed (Galal et al., 2017).

A 2017 ECRI review of peer-reviewed literature assessing the XEN® gel stent implantation system cites the studies of Grover and De Gregorio (above) as well as 2 other small single center case series (total n=134) published between January 1, 2012, and June 1, 2017. While most patients experienced a reduction in both IOP and glaucoma medication use post-implantation, the reviewers found the evidence in the 4 small case series to be inconclusive for both safety and efficacy. Larger, longer-term, controlled studies comparing XEN® with trabeculectomy are needed (2 of which are currently in progress).

To assess the safety and efficacy of phacoemulsification combined with XEN45 implant surgery, a prospective study was conducted on 30 eyes of patients with cataract and OAG. Surgery was performed using 2 temporal incisions within 15 minutes of administering subconjunctival mitomycin C. Outcomes measured were BCVA, IOP before and 1 day, 1 month, 3 months, 6 months, 9 months, and 12 months after surgery, number of anti-glaucoma medications, and AEs. BCVA before and 12 months post-surgery was 0.37±0.2 and 0.72±0.15, respectively. The pre-operative IOP was 21.2±3.4mmHg, with 3.07 drugs, decreasing by 61.65% on the first day, 37.26% at 1 month, 35.05% at 3 months, 31% at 6 months, 30.6% at 9 months, and 29.34% at 12 months. Anti-glaucoma medication usage decreased by 94.57%. Complications occurred in 3 eyes: 2 of them were excluded because the implantation could not be completed, and 1 developed an encapsulated bleb at 5 months post-surgery. The authors concluded that phacoemulsification combined with XEN45 implant surgery can effectively reduce IOP and the number of drugs in mild-moderate OAG with few complications (Pérez-Torregrosa, et al., 2016).

There are multiple clinical trials in progress relating to the XEN® Glaucoma Treatment System. For more information, please go to www.clinicaltrials.gov. (Accessed November 14, 2018)

HYDRUS® Microstent

Samuelson et al. (2018) conducted a prospective, multicenter, single-masked, RCT known as the HORIZON study. Subjects (n=556) with concomitant POAG, visually significant cataract, and washed-out modified diurnal IOP (MDIOP) between 22 and 34 mmHg were randomized 2:1 to receive a single Hydrus Microstent (HMS, n=369) (Ivantis, Inc., Irvine, CA) in the Schlemm canal or no microstent (NMS, n=187) after uncomplicated phacoemulsification. Primary effectiveness measurements were the proportion of subjects demonstrating a 20% or greater reduction in unmedicated MDIOP and change in mean MDIOP from baseline at 24 months, respectively. Secondary end points measured included use of hypertensive medication as well as frequency of surgical complications and AEs. Comprehensive eye examinations were conducted 1 day, 1 week, and at 1, 3, 6, 12, 18, and 24 months postoperatively. Medication washout and MDIOP measurement were repeated at 12 and 24 months. At 24 months, unmedicated MDIOP was reduced by ≥20% in 77.3% of HMS group eyes and in 57.8% of NMS group eyes (difference = 19.5%). The mean reduction in 24-month unmedicated MDIOP was −7.6±4.1 mmHg (mean ± standard deviation) in the HMS group and −5.3±3.9 mmHg in the NMS group (difference = −2.3 mmHg). The mean number of medications was reduced from 1.7±0.9 at baseline to 0.3±0.8 at 24 months in the HMS group and from 1.7±0.9 to 0.7±0.9 in the NMS group (difference = −0.4 medications). There were no serious ocular AEs related to the microstent, and no significant differences in safety parameters between the 2 groups. Researchers concluded that the HMS combined with cataract surgery demonstrated greater IOP lowering than cataract surgery alone at 12 and 24 months. Overall safety was equivalent in the 2 groups, with the exception of higher rates of adhesion formation in the microstent group and higher rates of IOP-related complications in the NMS group. Long-term head-to-head studies should be undertaken to better compare the safety and efficacy of HMS implantation with other novel MIGS procedures.

Pfeiffer et al. (2015) conducted a prospective, multicenter, randomized, single-masked, controlled clinical trial known as HYDRUS II to evaluate the safety and efficacy of the Hydrus Microstent with concurrent cataract surgery (CS) for IOP reduction in OAG. One hundred eyes from 100 patients 21-80 years of age with OAG and cataract with IOP of 24 mmHg or less with 4 or fewer hypotensive medications and a washed-out diurnal IOP (DOI) of 21 to 36 mmHg were included. On the day of surgery, participants were randomized 1:1 to undergo CS with the microstent or CS alone. Postoperative follow-up was at 1 day, 1 week, and 1, 3, 6, 12, 18, and 24 months. Washout of hypertensive medications was repeated at 12 and 24 months. Main outcome measures were a 20% or more decrease in washed out DOI at 12 and 24 months of follow-up compared with baseline. MDIOP at 12 and 24 months, the proportion of subjects requiring medications at follow-up, and the mean number of medications were also analyzed. Safety measures included change in visual acuity, slit-lamp observations, and AEs. Compared to the CS alone group, the proportion of patients with a 20% reduction in washed out MDIOP was significantly higher in the Hydrus plus CS group at 24 months (80% vs. 46%). Washed out MDIOP in the Hydrus plus CS group was significantly lower at 24 months.
Glaucoma Surgical Treatments

needed for all MIGS devices to better evaluate clinical and economic effectiveness.

and 1 Hydrus and other non-RCTs that compared MIGS surgery with medical therapy or other MIGS. MIGS is still limited and is based on few RCTs of acceptable quality and a larger number of non-randomized studies and uncontrolled before/after case series. Although there is increasing interest on safer, standardized and minimally invasive surgeries, they suggest further comparative and randomized research.

Fea et al. (2017) conducted a prospective interventional case series comparing the reduction of IOP and glaucoma medications following selective laser trabeculoplasty (SLT) versus stand-alone placement of the Hydrus Microstent. Participants with uncontrolled POAG (n=56 eyes/56 patients) received either SLT (n = 25) or Hydrus implantation (n = 31) at 2 centers. Patients were evaluated at baseline and 1 day, 7 days, 1, 3, 6 and 12 months post-surgery. Primary outcome measures were IOP and use of glaucoma medications. There were no significant differences at baseline between groups. After 12 months, the Hydrus group had significant decreases in both IOP and medication use compared with baseline. In the SLT group, while there was a significant decrease in IOP, there was a 3-fold greater reduction in medication use in the Hydrus group compared with SLT. At 12 months, 47% of patients versus 4% were medication-free in the Hydrus and SLT groups, respectively. In the SLT group, members were complication-free. Three patients in the Hydrus group experienced a temporary reduction of visual acuity post-operatively, and 2 patients had post-operative IOP spikes that resolved within one week. The authors concluded that while both procedures are safe, the use of the Hydrus implant led to a significant and further reduction in medication dependence at 12 months.

**Glaucoma Drainage Devices Not Approved by the U.S. Food and Drug Administration (FDA)**

**EyePass**

Dietlein et al. (2008) conducted a small study to evaluate the safety and pressure-reducing efficacy of the Y-shaped Eyepass glaucoma implant in 12 glaucoma and cataract patients, finding that combined cataract surgery with Eyepass shunt implantation was safe and appeared to be beneficial in glaucomatous eyes with cataract not requiring a low target IOP. Perforation of the trabecular meshwork during Eyepass implantation occurred in 2 eyes requiring explantation. In the remaining 10 eyes, the mean maximum IOP was 30.4 mm Hg preoperatively, 12.0 mm 1 day postoperatively, 17.2 mm Hg at 4 weeks, and 18.3 mm at the end of the preliminary follow-up.

**SOLX Gold Shunt**

2 clinical trials are listed for the SOLX Gold Shunt. One Phase III trial has been completed, but no data has yet been published ([http://clinicaltrials.gov/ct2/show/NCT01282346](http://clinicaltrials.gov/ct2/show/NCT01282346)). The other trial has suspended participant recruitment ([http://clinicaltrials.gov/ct2/show/NCT00382395](http://clinicaltrials.gov/ct2/show/NCT00382395)). (Accessed November 6, 2018)

**MIGS**

To analyze the change in IOP and glaucoma medications using different MIGS devices, as a solo procedure or in association with phacoemulsification, Lavia et al. (2017) conducted a systematic review and meta-analysis (registered on PROSPERO, CRD42016037280). The review included over 3069 studies (9 RCTs and 21 non-randomized case series) with follow up of at least one year on a total of 2928 eyes. The main outcomes were the effects of MIGS devices compared to medical therapy, cataract surgery, other glaucoma surgeries, and other MIGS on both glaucoma medication use and IOP 12 months post-surgery. Outcome measurements were the mean difference in the change of IOP and medication usage compared to baseline at 1 and 2 years, as well as all ocular AEs. Limited evidence was found based on both RCTs and non-RCTs that compared MIGS surgery with medical therapy or other MIGS. MIGS seemed effective in before-after series in lowering both IOP and glaucoma drug use and showed a good safety profile, with IOP spikes being the most frequent complication. No cases of infection or best corrected visual acuity loss due to glaucoma were reported. The reviewers found that the evidence on the efficacy of MIGS compared to other therapies is still limited and is based on few RCTs of acceptable quality and a larger number of non-randomized studies and uncontrolled before/after case series. Although there is increasing interest on safer, standardized and minimally invasive surgeries, they suggest further comparative and randomized research.

Agrawal and Bradshaw conducted a systematic review of clinical and economic outcomes of MIGS in POAG. From an economic standpoint, 23 studies were analyzed. Using the Cochrane Risk of Bias tool, clinical outcomes and safety were assessed using RCTs comparing MIGS with trabeculectomy or other therapies, as well as observational studies and other non-RCTs. A total of 9 RCTs (7 iStents®, 1 Hydrus®, and 1 CyPass®), and 7 non-RCTs (3 iStent®, 3 CyPass®, and 1 Hydrus®) were analyzed. The devices described in this review were typically associated with higher postoperative IOP levels, resulting in increased hypotony rates or bleb needling in subconjunctival placed devices. There is limited available evidence on the cost-effectiveness of MIGS, therefore actual cost savings information remains unclear. The authors concluded that larger randomized trials and ‘real-world’ observational studies are needed for all MIGS devices to better evaluate clinical and economic effectiveness.
Professional Societies

American Academy of Ophthalmology (AAO)
The AAO Preferred Practice Patterns Committee and Glaucoma Panel (2015) considered viscocanalostomy and canaloplasty in their report on POAG. The following statements were made regarding these alternatives to current glaucoma surgery:

- The precise role of nonpenetrating surgery in the surgical management of glaucoma remains to be determined.
- The 2 main types of nonpenetrating glaucoma surgery are viscocanalostomy and nonpenetrating deep sclerectomy.
- The rationale for nonpenetrating glaucoma surgery is that by avoiding a continuous passageway from the anterior chamber to the subconjunctival space, the incidence of complications such as bleb-related problems and hypotony can be reduced.
- The nonpenetrating procedures have a higher degree of surgical difficulty compared with trabeculectomy and require special instrumentation.
- RCTs comparing viscocanalostomy with trabeculectomy generally suggest greater IOP reduction with trabeculectomy, but fewer complications with viscocanalostomy. No RCTs comparing trabeculectomy and canaloplasty exist.

On the topic of combining glaucoma and cataract surgery, the AAO Preferred Practice Patterns Guidelines states:

- The decision of which procedure(s) to perform first or whether to combine cataract and glaucoma surgery is determined by the ophthalmologist and patient.
- Generally, combined cataract and glaucoma surgery is not as effective as glaucoma surgery alone in lowering IOP, so patients who require filtration surgery who also have mild cataract may be better served by filtration surgery alone and cataract surgery later.
- A systematic review published in 2002 found moderate quality evidence that separating the cataract and glaucoma incisions results in lower IOP than a one-site combined procedure, but the differences in outcomes were small. Subsequent publications have found no difference between the 2 approaches (2015).

An AAO Ophthalmic Technology Assessment by Minckler et al. (2008) provided an evidence-based summary of commercially available aqueous shunts currently used in substantial numbers (Ahmed, Baerveldt, Krupin, and Molteno) that are used to control IOP in various glaucomas. Although the primary indication for aqueous shunts is when prior medical or surgical therapy has failed, they may be used as primary surgical therapy for selected conditions such as trauma, chemical burns, or pemphigoid (level III evidence - case series, case reports, and poor quality cohort and case-control studies). Based on level I evidence, aqueous shunts seem to have benefits (IOP control, duration of benefit) comparable with those of trabeculectomy in the management of complex glaucomas (phakic or pseudophakic eyes after prior failed trabeculectomies). Level I evidence indicates that there are no advantages to the adjunctive use of anti-fibrotic agents or systemic corticosteroids with currently available shunts. Too few high-quality direct comparisons of various available shunts have been published to assess the relative efficacy or complication rates of specific devices beyond the implication that larger-surface-area explants provide more enduring and better IOP control. Long-term follow-up and comparative studies are encouraged.

An AAO Technology Assessment on novel glaucoma procedures (Francis et al, 2011) provided an evidence-based summary of clinically relevant information on novel devices for treating OAG (e.g., iStent®, EX-PRESS™ mini glaucoma shunt, SOLX® Gold Shunt). The authors concluded that the novel glaucoma surgeries studied all showed some promise as alternative treatments to lower IOP in the treatment of OAG. However, their report states that it is not possible to conclude whether these novel procedures are superior, equal to, or inferior to surgery such as trabeculectomy or to one another.

AAO references do not reflect that the organization has taken a position on the CyPass® Micro-Stent System, the XEN® Glaucoma Treatment System, or the HYDRUS® Microstent.

Canadian Ophthalmological Society
This society’s guidelines for the management of glaucoma in the adult eye lists viscocanalostomy under other strategies for the surgical management of coexisting cataract and glaucoma, but the guideline developers report that there is insufficient scientific evidence comparing these procedures to phaco-trabeculectomy (2009).

U.S. FOOD AND DRUG ADMINISTRATION (FDA)
Viscocanalostomy and Canaloplasty
Specialized devices used for viscocanalostomy and canaloplasty are regulated by the FDA as Class II devices. Additional information is available at: [http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm](http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm) under product codes HMX (cannula, ophthalmic), MPA (endoilluminator), or MRH (pump, infusion, ophthalmic).

(Accessed December 5, 2018)
The Canaloplasty Ophthalmic Microcannula, or iTRACK, is a flexible microcannula designed to allow atraumatic cannulation of spaces in the eye such as the anterior chamber and posterior segment, for infusion and aspiration of fluids during surgery, including saline and viscoelastics. The FDA approved the Ophthalmic Microcannula in August 2006. Additional information is available at: https://www.accessdata.fda.gov/cdrh_docs/pdf6/k062259.pdf. (Accessed December 5, 2018)

**Glaucoma Drainage Devices**


Predicate Devices include the Molteno Implant (K890598 and K902489), the Baerveldt Glaucoma Implant (K905129 and K955455), the Krupin Eye Valve (K885125 and K905703), the Ahmed Glaucoma Valve Implant (K925636), and the XEN® Glaucoma Treatment System (K161457). Additional information is available at: http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm073806.pdf. (Accessed December 5, 2018)

iStent® Trabecular Micro-Bypass Stent System, Model GTS100R/L, was approved by the FDA on June 25, 2012. This device is approved for use in combination with cataract surgery to reduce IOP in adult patients with mild to moderate OAG and a cataract who are currently being treated with medication to reduce IOP. Additional information is available at: http://www.accessdata.fda.gov/cdrh_docs/pdf8/p080030b.pdf. (Accessed December 5, 2018)

CyPass® System, Model 241-S, was approved by the FDA on July 29, 2016. This device is approved for microinvasive glaucoma surgery (MIGS) in combination with cataract surgery, and is indicated to reduce IOP in adults with mild-to-moderate POAG. Additional information is available at: https://www.accessdata.fda.gov/cdrh_docs/pdf15/p150037b.pdf. (Accessed December 5, 2018)

Hydrus® Microstent was approved by the FDA on August 10, 2018. This device is approved for use in conjunction with cataract surgery for the reduction of IOP in adult patients with mild to moderate POAG. Additional information is available at: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMA/pma.cfm?id=P170034. (Accessed December 5, 2018)

**CENTERS FOR MEDICARE AND MEDICAID SERVICES (CMS)**

Medicare does not have a National Coverage Determination (NCD) for glaucoma drainage devices used for treating refractory glaucoma when medical or surgical treatments have failed or are inappropriate. Local Coverage Determinations (LCDs) exist; see the LCDs for Category III Codes, Micro-Invasive Glaucoma Surgery (MIGS), Non-Covered Category III CPT Codes and Non-Covered Services.

Medicare does not have an NCD for the insertion of the iStent® Trabecular Micro-Bypass Stent System for treating mild to moderate open-angle glaucoma when used in combination with cataract surgery. LCDs exist; see the LCDs for Category III CPT Codes and Micro-Invasive Glaucoma Surgery (MIGS).

Medicare does not have an NCD for canaloplasty or viscoanalostomy when used in the surgical treatment of glaucoma. LCDs do not exist at this time.

Medicare does not have an NCD for the CyPass® Micro-Stent System when used in combination with cataract surgery for the treatment of glaucoma (POAG). LCDs exist; see the LCDs for Category III CPT Codes, Micro-Invasive Glaucoma Surgery (MIGS) and Non-Covered Category III CPT Codes.

Medicare does not have an NCD for the Xen® Glaucoma Treatment System or Hydrus® Microstent System. LCDs do not exist at this time.

Medicare does not have an NCD for any glaucoma drainage devices that are not FDA approved. LCDs do not exist at this time. (Accessed December 10, 2018)

**REFERENCES**


Koerber NJ. Canaloplasty in one eye compared with viscocanalostomy in the contralateral eye in patients with bilateral open-angle glaucoma. J Glaucoma. 2012 Feb;21(2):129-34.


**POLICY HISTORY/REVISION INFORMATION**

<table>
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<tr>
<th>Date</th>
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| 04/01/2019 | • Revised and reformatted coverage rationale:  
  o Simplified content  
  o Replaced language indicating:  
    ▪ “The iStent® Trabecular Micro-Bypass Stent System is proven and medically necessary when used in combination with cataract surgery for treating mild to moderate open-angle glaucoma and a cataract in adults currently being treated with ocular hypotensive medication” with “the iStent® Trabecular Micro-Bypass Stent System is proven and medically necessary for treating mild to moderate open-angle glaucoma when used in combination with cataract surgery”  
    ▪ “The CyPass® Micro-Stent System is unproven and not medically necessary when used in combination with cataract surgery for treating mild-to-moderate primary open-angle glaucoma (POAG)” with “the CyPass® Micro-Stent System is unproven and not medically necessary for treating any type of glaucoma”  
    ▪ “The Xen® Glaucoma Treatment System is unproven and is not medically necessary for treating refractory glaucoma when conventional medical or surgical treatments have failed, or in patients with primary open-angle glaucoma, pseudoexfoliative or pigmentary glaucoma with open angles that are unresponsive to maximum tolerated medical therapy” with “the Xen® Glaucoma Treatment System is unproven and is not medically necessary for treating any type of glaucoma”  
  o Added language to indicate the Hydrus® Microstent is unproven and not medically necessary for treating any type of glaucoma due to insufficient evidence of efficacy and/or safety  
  • Updated list of applicable CPT codes; added 66170  
  • Updated supporting information to reflect the most current description of services, clinical evidence, FDA and CMS information, and references  
  • Archived previous policy version 2018T0443V |

**INSTRUCTIONS FOR USE**

This Medical Policy provides assistance in interpreting UnitedHealthcare standard benefit plans. When deciding coverage, the member specific benefit plan document must be referenced as the terms of the member specific benefit plan may differ from the standard plan. In the event of a conflict, the member specific benefit plan document governs. Before using this policy, please check the member specific benefit plan document and any applicable federal or state mandates. UnitedHealthcare reserves the right to modify its Policies and Guidelines as necessary. This Medical Policy is provided for informational purposes. It does not constitute medical advice.

This Medical Policy may also be applied to Medicare Advantage plans in certain instances. In the absence of a Medicare National Coverage Determination (NCD), Local Coverage Determination (LCD), or other Medicare coverage guidance, CMS allows a Medicare Advantage Organization (MAO) to create its own coverage determinations, using objective evidence-based rationale relying on authoritative evidence (Medicare IOM Pub. No. 100-16, Ch. 4, §90.5).

UnitedHealthcare may also use tools developed by third parties, such as the MCG™ Care Guidelines, to assist us in administering health benefits. UnitedHealthcare Medical Policies are intended to be used in connection with the independent professional medical judgment of a qualified health care provider and do not constitute the practice of medicine or medical advice.