

## Glaucoma Surgery

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### Summary

Glaucoma is a medical condition where increased pressure on the nerve responsible for vision leads to peripheral vision loss. It is the leading cause of blindness in people over the age of 60. The most common subtype is called open-angle glaucoma, where the drainage system of the eye gets “clogged” and cannot drain fluid quickly enough, resulting in a gradual buildup of intraocular pressure. The second subtype is angle-closure glaucoma, where the drainage system is completely and often acutely blocked, resulting in a more rapid increase in pressure and sudden-onset symptoms. Most people with glaucoma are not aware of the symptoms until the disease has progressed significantly. Diagnosis is usually performed by an ophthalmologist and at-risk patients may require regular screening exams. For most patients, treatment with oral and/or topical medications is adequate to control the intraocular pressure. For patients who continued to have elevated pressure despite appropriate medical therapy, a number of surgical or minimally invasive options are available for treatment. This guideline provides coverage criteria, exclusions, and benefit details for the surgical and minimally invasive treatment of glaucoma. These procedures should be performed by a licensed ophthalmologist with expertise in the selected procedure.

### Definitions

**“Intraocular Pressure”** (i.e., IOP) is the pressure that is generated by the fluid inside of the eye known as **“Aqueous Humor.”**

**“Trabecular Meshwork”** is a structure in the anterior portion of the eye that drains the aqueous humor via a structure called Schlemm’s canal and into the general blood circulation.

**“Optic Nerve”** is the nerve responsible for vision. When compressed or damaged, visual loss may occur.

**“Glaucoma”** is an irreversible condition where damage occurs to the optic nerve resulting in visual impairment. Risk factors include increased intraocular pressure, obesity, high blood pressure, and family history. Open-angle glaucoma is thought to occur when the fluid in the eye drains through the trabecular network too slowly, resulting in slow increase in pressure. Acute-angle glaucoma occurs when the iris blocks the trabecular meshwork, resulting in rapid increase in pressure and more sudden and severe symptoms. The specific treatments for each type of glaucoma differ, however, the goal is to reduce intraocular pressure in both.

#### **“American Academy of Ophthalmology Glaucoma Severity Scale”**

- **Mild:** Optic nerve abnormalities consistent with glaucoma and a normal visual field as tested with standard automated perimetry
- **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 standard automated perimetry
- **Severe:** Optic nerve abnormalities consistent with glaucoma as and visual field abnormalities in both hemifields and/or loss within 5 degrees of fixation in at least one hemifield as tested with standard automated perimetry

**“Trabeculoplasty”** is a laser treatment for open-angle glaucoma where a small hole is created in the trabecular meshwork, most often using an argon laser (“Argon Laser Trabeculoplasty” or “ALT”). It can also be performed as “selective laser trabeculoplasty” or “SLT”, where a different type of laser is used.

**“Trabeculectomy”** is a surgical procedure similar to trabeculoplasty, except that instead of laser treatment, a small part of the trabecular meshwork is removed surgically.

**“Laser Iridotomy”** is a laser treatment for acute-angle glaucoma to create a small opening in the iris to reduce the intraocular pressure.

**“Laser Iridoplasty”** is a procedure using laser energy to shrink the peripheral iris; also called gonioplasty.

**“Iridectomy”** is the surgical removal of part of the iris.

**“Glaucoma Drainage Implants or Aqueous Shunts”** are small implants or gel-like substances used to relieve pressure inside anterior chamber by shunting the aqueous humor elsewhere in an effort to reduce intraocular pressure.

**“Canaloplasty”** is considered one of the non-penetrating procedures for glaucoma, where a small incision is made and a microcatheter is inserted to open up the canal of Schlemm in order to reduce intraocular pressure.

**“Viscocanalostomy”** is similar to canaloplasty except that that instead of a microcatheter, a viscous gel-like substance is injected to open the canal. It also differs in that the canal is only partially opened, where it is fully expanded in canaloplasty.

**“Ocular Drug-Eluting Stents or Implants”** include an array of procedures and devices that are implanted into or onto structures of the eye to automatically release ocular medications directly.

**“Cyclodestruction”** or **“Cyclophotocoagulation”** refers to the use of laser or endoscopic intervention to decrease the rate of aqueous fluid production through destruction of ciliary body function.

## Clinical Indications and Coverage

### General Coverage Criteria

Oscar covers surgery or procedures for glaucoma when **ALL** of the following are met:

1. The procedure or surgery is **ONE** of the following:
  - a. Selective or argon laser trabeculoplasty; **or**
  - b. Surgical trabeculoplasty; **or**
  - c. Surgical trabeculectomy; **or**
  - d. Ahmed glaucoma valve implant; **or**
  - e. Baerveldt tube shunt; **or**
  - f. ExPRESS mini glaucoma shunt; **or**
    - i. *Note: Adjunctive use of antifibrotic agents with ExPRESS mini shunt are considered medically necessary and covered*
  - g. Krupin-Denver eye valve; **or**
  - h. Molteno implant.
2. The member has a documented diagnosis of primary open-angle glaucoma; **and**

3. An adequate trial of first-line (e.g., latanoprost or timolol) **AND** second-line (e.g., brimonidine or dorzolamide) medications have failed to control intraocular pressure.
  - a. *Note: Members who are unlikely to be compliant with topical therapy may qualify for laser trabeculoplasty as a first-line treatment when documented by the treating physician*

### **Canaloplasty**

Oscar covers canaloplasty when **ALL** of the following are met:

1. An adequate trial of first-line (e.g. latanoprost or timolol) **AND** second-line (e.g. brimonidine or dorzolamide) medications have failed to control intraocular pressure; **and**
2. The member is not a candidate for the above covered procedures (a-h) due to specific contraindications, is high-risk due to other comorbidities, or has an anatomical abnormality; **and**
3. The procedure is performed by a physician with expertise in the procedure and the appropriate instrumentation.

### **iStent Procedure**

Oscar covers the FDA-approved iStent Procedure when **ALL** of the following are met:

1. The member has mild to moderate primary open angle glaucoma; **and**
2. Cataract in the same eye as the glaucoma; **and**
3. Current treatment with ocular hypotensive medication(s); **and**
4. The iStent Procedure is performed simultaneous to the cataract surgery; **and**
5. No contraindications, as outlined in the Non-Covered Services and Indications section below, have been identified.

### **Cyclophotocoagulation**

Oscar covers cyclophotocoagulation (either transscleral CPC or endoscopic) when any **ONE** of the following criteria are met:

1. Member is a poor candidate for glaucoma filtration surgery or drainage implant due to comorbidities or contraindications; **or**
2. Pain relief is desired due to elevated IOP in a blind, painful eye; **or**
3. Elevated IOP in an eye with poor vision or poor visual potential; **or**
4. Glaucoma refractory to first and second line treatment as defined above.

## CyPass System

Oscar covers the FDA approved CyPass System when **ALL** of the following criteria are met:

1. The member has mild to moderate primary open angle glaucoma; **and**
2. Cataract in the same eye as the glaucoma; **and**
3. Current treatment with ocular hypotensive medication(s); **and**
4. The iStent Procedure is performed simultaneous to the cataract surgery; **and**
5. No contraindications, as outlined in the Non-Covered Services and Indications section below, have been identified; **and**
6. Gonioscopy should be performed prior to surgery to exclude peripheral anterior synechiae (PAS), rubeosis, and other angle abnormalities or conditions that would prohibit adequate visualization of the angle.

## Laser (nd:YAG) Iridotomy

Oscar covers thermal or laser (nd:YAG) iridotomy when at least **ONE** of the following criteria is met:

1. Treatment of an eye with acute angle closure glaucoma or acute angle closure crisis; **or**
2. Treatment of the contralateral eye when the other eye has had an episode of angle closure **AND** the chamber angle is anatomically narrow in the contralateral eye.

## Laser Iridoplasty and Surgical Iridectomy

Oscar covers laser iridoplasty or surgical iridectomy when at least **ONE** of the following criteria is met:

1. Treatment of an eye with acute angle closure crisis (AACC) when laser iridotomy is not possible; **or**
2. Treatment of an eye with AACC that cannot be medically broken.

## Coverage Exclusions

Oscar does **NOT** cover procedures or surgeries which are experimental, unproven, or investigational, including, but not limited to, the following:

1. Transciliary filtration (e.g. Fugo Blade, Singh Filtration)
  - a. *Rationale for non-coverage:* The evidence for the Singh Filtration procedure and the updated version (Fugo Blade) are limited to case series and reports on feasibility by the primary author. Further large-scale, randomized trials with long-term outcomes and comparison to validated techniques are required to guide clinical implementation.<sup>64-66</sup>
2. Glaucoma drainage devices or stents that are not FDA approved, including, but not limited to, the following:
  - a. EyePass Glaucoma Implant

- b. DeepLight SOLX Gold Shunt
  - c. Istent G3 Supra
  - d. Istent Inject
  - e. STARflo
  - f. Aquashunt
  - g. Hydrus MicroStent
3. Xen Gel stent
- a. *Rationale for non-coverage:* The existing peer-reviewed literature on the Xen Gel Stent is limited to case reports, animal studies, retrospective reviews, and small prospective studies. While initial results may be promising, there is inadequate randomized, large-scale, long-term data to guide clinical implementation.<sup>67-70</sup>
4. CyPass Micro-Stent or other ab intern suprachoroidal microstent procedures are not covered in members not meeting criteria above or with the following contraindications per the FDA approval guidelines:
- a. Angle closure glaucoma
  - b. In eyes with traumatic, malignant, uveitic, or neovascular glaucoma or discernible congenital anomalies of the anterior chamber (AC) angle
5. Any drug-eluting implant or stent, including but not limited to the following, as they lack FDA-approval and there is insufficient peer-reviewed evidence for use in glaucoma:
- a. OTX-DP
  - b. Bimatoprost SR
  - c. Travoprost XR
  - d. MicroPump
6. Beta radiation
- a. *Rationale for non-coverage:* Kirwan et al (2009) performed a Cochrane review on beta radiation during trabeculectomy and found 4 trials randomizing 551 total patients. They concluded that there was a lower risk of failure but higher rates of cataract formation, and that direct comparisons to antimetabolite treatment were needed. Dhalia et al (2016) performed this direct comparison of beta radiation vs. 5-FU in 301 randomized patients in an African population and found “no evidence of an important difference between the use of 5FU and beta radiation...”. Further, large-scale, randomized trials are needed to confirm any potential benefit with beta radiation in this setting.<sup>71-72</sup>
7. Ab interno trabeculectomy (e.g. Trabectome)
- a. *Rationale for non-coverage:* The literature on the efficacy, safety, and long-term outcomes of trabectome is insufficient and limited to case reports and small retrospective reviews. Kaplowitz et al (2016) performed a systematic review of 17 studies

(12 case series, 5 retrospective) looking at ab interno trabeculectomy. 14 of the studies met inclusion criteria. Average success rates ranged from 12-80%. At the present time, further evidence with prospective, large, randomized trials is required to determine the clinical application of this technique. Furthermore, the FDA has not approved the Trabectome for use in glaucoma and issued a warning letter to the company in 2014 regarding this application.<sup>73-78</sup>

8. Subconjunctival antivascular endothelial growth factor injections to control wound healing
  - a. *Rationale for non-coverage:* The clinical efficacy of these injections has not yet been established, limiting clinical use to the experimental and investigational setting.
9. Viscoanalostomy
  - a. *Rationale for non-coverage:* There is a general lack of long-term randomized data on this procedure, and many of the existing studies demonstrate inferior efficacy in lowering IOP. Kobayashi et al (2003) compared viscoanalostomy and trabeculectomy on lowering intraocular pressure in 25 patients with primary open-angle glaucoma, and found that viscoanalostomy had fewer complications but was inferior at lowering IOP. They concluded that the role of this procedure needed further data to guide widespread clinical implementation. Studies by several other groups have found similar findings to the Kobayashi study. A meta-analysis by Chai et al (2010) looked at 10 randomized controlled trials comparing viscoanalostomy with trabeculectomy and found the latter was superior in lowering IOP, reducing post-operative medication needs, and had a lower relative risk of perforation of Descemet membrane. Further long-term, randomized evidence is needed to define the clinical role of viscoanalostomy.<sup>79-84</sup>
10. Any of the covered procedures in members not meeting the specific criteria above or in members with any of the following procedure-specific exclusions:
  - a. Canaloplasty is contraindicated and should not be used in the following situations:
    - i. Chronic angle closure
    - ii. Narrow angles
    - iii. Angle recession
    - iv. Neovascular glaucoma
    - v. Ocular hypertension due to increased episcleral venous pressure
    - vi. Previous surgery that precludes Schlemm's canal cannulation such as trabeculectomy, trabeculotomy, goniotomy, and argon laser trabeculoplasty
  - b. iStent Procedure should not be used in the following situations as it has not been adequately studied or approved:
    - i. Children
    - ii. Prior significant eye trauma

- iii. Abnormal anterior segment
  - iv. Eyes with chronic inflammation
  - v. Glaucoma associated with vascular disorders, uveitic glaucoma, pseudophakic glaucoma
  - vi. Prior glaucoma surgery, including any type of trabeculoplasty
  - vii. Medicated intraocular pressure >24 mmHg
  - viii. Unmedicated intraocular pressure <22 or >36
  - ix. For implantation of more than one stent
  - x. After complications of cataract surgery
- c. iStent Procedure is contraindicated and should not be used in the following situations:
- i. Primary or secondary angle-closure glaucoma
  - ii. Neovascular glaucoma
  - iii. Retrobulbar tumor
  - iv. Thyroid eye disease
  - v. Sturge-Weber syndrome or port-wine stain involving the eye

**Applicable Billing Codes (CPT/HCPCS/ICD-10 Codes)**

<b>CPT/HCPCS Codes covered if criteria are met:</b>	
<i>Code</i>	<i>Description</i>
65850	Trabeculotomy ab externo
65855	Trabeculoplasty by laser surgery
66170	Fistulization of sclera for glaucoma; trabeculectomy ab externo in absence of previous surgery <b>[Trabeculectomy]</b>
66172	Fistulization of sclera for glaucoma; trabeculectomy ab externo in presence of previous surgery <b>[Trabeculectomy]</b>
66174	Transluminal dilation of aqueous outflow canal; without retention of device or stent <b>[Canaloplasty]</b>
66175	Transluminal dilation of aqueous outflow canal; with retention of device or stent <b>[Canaloplasty]</b>
66179	Aqueous shunt to extraocular equatorial plate reservoir, external approach; without graft
66180	Aqueous shunt to extraocular equatorial plate reservoir, external approach; with graft



66183	Insertion of anterior segment aqueous drainage device, without extraocular reservoir, external approach <b>[ExPress Mini Shunt]</b>
66184	Revision of aqueous shunt to extraocular equatorial plate reservoir; without graft
66185	Revision of aqueous shunt to extraocular equatorial plate reservoir; with graft
66710	Ciliary body destruction; cyclophotocoagulation, transscleral
66711	Ciliary body destruction cyclophotocoagulation, endoscopic
66720	Ciliary body destruction; cryotherapy
66761	Iridotomy/iridectomy by laser surgery (eg, for glaucoma) (per session)
C1783	Ocular implant, aqueous drainage assist device <b>[iStent]</b>
L8612	Aqueous shunt
0191T	Insertion of anterior segment aqueous drainage device, without extraocular reservoir; internal approach, into the trabecular meshwork <b>[iStent]</b>
0253T	Insertion of anterior segment aqueous drainage device, without extraocular reservoir; internal approach, into the suprachoroidal space <b>[Cypass Stent]</b>
0376T	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) <b>[Use with 0191T]</b>
0474T	Insertion of anterior segment aqueous drainage device, with creation of intraocular reservoir, internal approach, into the supraciliary space
<b>ICD-10 codes covered if criteria are met:</b>	
H40.1110- H40.1194	Primary open-angle glaucoma
<b>Additional ICD-10 codes required for iStent 0191T and Cypass 0253T:</b>	
H25.011 - H26.9	Cataract <b>[must be billed with H40.1110 - H40.1194]</b>
<b>ICD-10 codes covered for thermal or laser iridotomy (66761) if criteria are met:</b>	
H40.211 – H40.219	Acute angle-closure glaucoma

<b>ICD-10 codes not covered for Cypass MicroStent (0253T):</b>	
<i>Code</i>	<i>Description</i>
H40.20 - H40.249	Angle closure glaucoma
H40.30x0 - H40.33x4	Glaucoma secondary to eye trauma
H40.40x0 - H40.43x4	Glaucoma secondary to eye inflammation [ <b>uveitic glaucoma</b> ]
H40.831 - H40.839	Aqueous misdirection [ <b>malignant glaucoma</b> ]
H42	Glaucoma in diseases classified elsewhere
Q13.0 - Q13.9	Congenital malformations of anterior segment of eye
<b>ICD-10 codes not covered for canaloplasty (66174, 66175):</b>	
H21.551 - H21.559	Recession of chamber angle
H40.031 - H40.039	Anatomical narrow angle
H40.051 - H40.059	Ocular hypertension
H40.221 - H40.229	Chronic angle-closure glaucoma
H40.50x0 - H40.53x4	Glaucoma secondary to other eye disorders
H40.89	Other specified glaucoma
<b>ICD-10 codes not covered for the iStent Procedure (0191T, C1783)</b>	
C69.60 - C69.62	Malignant neoplasm of orbit
E05.00 - E05.01	Thyrotoxicosis with diffuse goiter

H04.021 - H04.029	Chronic dacryoadenitis
H04.031 - H04.039	Chronic enlargement of lacrimal gland
H04.411 - H04.419	Chronic dacryocystitis
H04.421 - H04.429	Chronic lacrimal canaliculitis
H05.10	Unspecified chronic inflammatory disorders of orbit
H20.10 - H20.13	Chronic iridocyclitis
H40.051 - H40.059	Ocular hypertension
H40.20x0 - H40.20x4	Primary angle-closure glaucoma
H40.300 - H40.334	Glaucoma secondary to eye trauma
H40.411 - H40.434	Glaucoma secondary to eye inflammation
H40.50x0 - H40.53x4	Glaucoma secondary to other eye disorders
H40.89	Other specified glaucoma
H59.011 - D59.099	Disorders of the eye following cataract surgery
Q85.8	Other phakomatoses, not elsewhere classified [ <b>Sturge-Weber Syndrome</b> ]

<b>CPT/HCPCS codes not covered:</b>	
<i>Code</i>	<i>Description</i>

65820	Goniotomy [ <b>when used for Ab interno trabeculectomy</b> ]
66170	Fistulization of sclera for glaucoma; trabeculectomy ab externo in absence of previous surgery [ <b>Viscocanalostomy</b> ]
66999	Unlisted procedure, anterior segment of eye [ <b>not covered for Trabectome, Viscocanalostomy, Transciliary fistulization/filtration</b> ]
77401 - 77412	Radiation treatment delivery
0123T	Fistulization of sclera for glaucoma, through ciliary body [ <b>Singh filtration</b> ]
0190T	Placement of intraocular radiation source applicator (List separately in addition to primary procedure)
0191T	Insertion of anterior segment aqueous drainage device, without extraocular reservoir, internal approach, into the trabecular meshwork; initial insertion
0356T	Insertion of drug-eluting implant (including punctual dilation and implant removal when performed) into lacrimal canaliculus, each
0376T	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)
0444T	Initial placement of a drug-eluting ocular insert under one or more eyelids, including fitting, training, and insertion, unilateral or bilateral
0445T	Subsequent placement of a drug-eluting ocular insert under one or more eyelids, including re-training, and removal of existing insert, unilateral or bilateral
0449T	Insertion of aqueous drainage device, without extraocular reservoir, internal approach, into the subconjunctival space; initial device [ <b>Xen Gel stent</b> ]
0450T	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) [ <b>Xen Gel stent</b> ]
G6001 - G6014	Radiation treatment delivery

## References

1. American Academy of Ophthalmology Glaucoma Panel. Primary open-angle glaucoma. Preferred Practice Pattern. San Francisco, CA: American Academy of Ophthalmology; 2015.

2. Barton K, Gedde SJ, Budenz DL, et al; Ahmed Baerveldt Comparison Study Group. The Ahmed Baerveldt Comparison Study methodology, baseline patient characteristics, and intraoperative complications. *Ophthalmology*. 2011;118(3):435-442.
3. Boland MV, Ervin AM, Friedman DS, et al. Comparative effectiveness of treatments for open-angle glaucoma: A systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2013;158(4):271-279.
4. Buchacra O, Duch S, Milla E, Stirbu O. One-year analysis of the iStent trabecular microbypass in secondary glaucoma. *Clin Ophthalmol*. 2011;5:321-326.
5. Burr J, Azuara-Blanco A, Avenell A, Tuulonen A. Medical versus surgical interventions for open angle glaucoma. *Cochrane Database Syst Rev*. 2012;9:CD004399.
6. Bussel II, Kaplowitz K, Schuman JS, et al. Outcomes of ab interno trabeculectomy with the trabectome after failed trabeculectomy. *Br J Ophthalmol*. 2015;99(2):258-262.
7. Cheng JW, Wei RL, Cai JP, Li Y. Efficacy and tolerability of nonpenetrating filtering surgery with and without implant in treatment of open angle glaucoma: A quantitative evaluation of the evidence. *J Glaucoma*. 2009;18(3):233-237.
8. Christakis PG, Tsai JC, Kalenak JW, et al. The Ahmed versus Baerveldt study: Three-year treatment outcomes. *Ophthalmology*. 2013;120(11):2232-2240.
9. Eldaly MA, Bunce C, Elsheikha OZ, Wormald R. Non-penetrating filtration surgery versus trabeculectomy for open-angle glaucoma. *Cochrane Database Syst Rev*. 2014;2:CD007059.
10. Eldaly MA, Bunce C, Elsheikha OZ, Wormald R. Non-penetrating filtration surgery versus trabeculectomy for open-angle glaucoma. *Cochrane Database Syst Rev*. 2014;2:CD007059.
11. Fea AM, Belda JI, Rekas M, et al. Prospective unmasked randomized evaluation of the iStent inject® versus two ocular hypotensive agents in patients with primary open-angle glaucoma. *Clin Ophthalmol*. 2014; 8:875-882.
12. Filippopoulos T, Rhee DJ. Novel surgical procedures in glaucoma: Advances in penetrating glaucoma surgery. *Curr Opin Ophthalmol*. 2008;19(2):149-154.
13. Francis BA, Singh K, Lin SC, et al. Novel glaucoma procedures: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2011;118(7):1466-1480.
14. Francis BA, Singh K, Lin SC, et al. Novel glaucoma procedures: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2011;118(7):1466-1480.
15. Francis BA, Winarko J. Ab interno Schlemm's canal surgery: Trabectome and i-stent. *Dev Ophthalmol*. 2012;50:125-136.
16. Ghate D, Wang X. Surgical interventions for primary congenital glaucoma. *Cochrane Database Syst Rev*. 2015;1:CD008213.
17. Green E, Wilkins M, Bunce C, Wormald R. 5-Fluorouracil for glaucoma surgery. *Cochrane Database Syst Rev*. 2014;2:CD001132.

18. Grieshaber MC, Fraenkl S, Schoetzau A, et al. Circumferential viscocanalostomy and suture canal distension (canaloplasty) for whites with open-angle glaucoma. *J Glaucoma*. 2011; 20(5):298-302.
19. Grieshaber MC, Peckar C, Pienaar A, et al. Long-term results of up to 12 years of over 700 cases of viscocanalostomy for open-angle glaucoma. *Acta Ophthalmol*. 2015; 93(4):362-367.
20. Grieshaber MC, Pienaar A, Olivier J, Stegmann R. Canaloplasty for primary open-angle glaucoma: long-term outcome. *Br J Ophthalmol*. 2010; 94(11):1478-1482.
21. Grover D, Kersten-Gomez I, Reitsamer H, Sheybani A. Describing the development of a minimally invasive collagen stent for treating glaucoma: first 975 eyes treated with the Xen Gel stent. Paper presented at: The 26th Annual AGS Meeting; March 3, 2016; Ft. Lauderdale, FL.
22. Heijl A, Leske MC, Bengtsson B, et al. Reduction of intraocular pressure and glaucoma progression: results from the Early Manifest Glaucoma Trial. *Arch Ophthalmol*. 2002; 120(10):1268-1279.
23. Hong CH, Arosemena A, Zurakowski D, Ayyala RS. Glaucoma drainage devices: a systematic literature review and current controversies. *Surv Ophthalmol*. 2005; 50(1):48-60.
24. Jacobs DS. Open-angle glaucoma: Treatment. UpToDate [online serial]. Waltham, MA: UpToDate; Accessed May 2017.
25. Jacobs DS. Open-angle glaucoma: Treatment. UpToDate Inc., Waltham, MA. Last reviewed March 2016.
26. Jea SY, Francis BA, Vakili G, et al. Ab interno trabeculectomy versus trabeculectomy for open-angle glaucoma. *Ophthalmology*. 2012;119(1):36-42.
27. Jordan JF, Engels BF, Dinslage S, et al. A novel approach to suprachoroidal drainage for the surgical treatment of intractable glaucoma. *J Glaucoma*. 2006; 15(3):200-205.
28. Kaplowitz K, Bussell II, Honkanen R, et al. Review and meta-analysis of ab-interno trabeculectomy outcomes. *Br J Ophthalmol*. 2016 Jan 5
29. Ke M, Guo J, Qian Z. Meta analysis of non-penetrating trabecular surgery versus trabeculectomy for the treatment of open angle glaucoma. *J Huazhong Univ Sci Technolog Med Sci*. 2011;31(2):264-270.
30. Kim DM, Lim KH. Aqueous shunts: Single-plate Molteno vs ACTSEB. *Acta Ophthalmol Scand*. 1995;73(3):277-280.
31. Kirwan JF, Rennie C, Evans JR. Beta radiation for glaucoma surgery. *Cochrane Database Syst Rev*. 2009;(2):CD003433.
32. Kobayashi H, Kobayashi K, Okinami S. A comparison of the intraocular pressure-lowering effect and safety of viscocanalostomy and trabeculectomy with mitomycin C in bilateral open-angle glaucoma. *Graefes Arch Clin Exp Ophthalmol*. 2003; 241(5):359-366.

33. Lewis RA, von Wolff K, Tetz M, et al. Canaloplasty: circumferential viscodilation and tensioning of Schlemm's canal using a flexible microcatheter for the treatment of open-angle glaucoma in adults: interim clinical study analysis. *J Cataract Refract Surg.* 2007; 33(7):1217-1226.
34. Lewis RA, von Wolff K, Tetz M, et al. Canaloplasty: circumferential viscodilation and tensioning of Schlemm canal using a flexible microcatheter for the treatment of open-angle glaucoma in adults: two-year interim clinical study results. *J Cataract Refract Surg.* 2009; 35(5):814-824.
35. Lewis RA, von Wolff K, Tetz M, et al. Canaloplasty: three-year results of circumferential viscodilation and tensioning of Schlemm canal using a microcatheter to treat open-angle glaucoma. *J Cataract Refract Surg.* 2011; 37(4):682-690.
36. Malvankar-Mahta MS, Iordanous Y, Chen YN, et al. iStent with phacoemulsification versus phacoemulsification alone for patients with glaucoma and cataract: a meta-analysis. *PLoS One.* 2015; 10(7):e0131770.
37. Maris P, Ishida K, Natland P. Comparison of trabeculectomy with Ex-PRESS miniature glaucoma device implanted under sclera. *J Glaucoma.* 2007; 16(1):14-19.
38. Matlach J, Dhillon C, Hain J, et al. Trabeculectomy versus canaloplasty (TVC study) in the treatment of patients with open-angle glaucoma: a prospective randomized clinical trial. *Acta Ophthalmol.* 2015; 93(8):753-761.
39. Matlach J, Klink T. Trabeculectomy versus canaloplasty. *Ophthalmologe.* 2015;112(4):325-331.
40. Melamed S, Fiore PM. Molteno implant surgery in refractory glaucoma. *Surv Ophthalmol.* 1990;34(6):441-448.
41. Minckler DS, Francis BA, Hodapp EA, et al. Aqueous shunts in glaucoma: A report by the American Academy of Ophthalmology. *Ophthalmology.* 2008;115(6):1089-1098.
42. Minckler DS, Hill RA. Use of novel devices for control of intraocular pressure. *Exp Eye Res.* 2009;88(4):792-798.
43. Moradian K, Daneshvar R, Saffarian L, et al. The efficacy of viscocanalostomy for uncontrollable primary open-angle glaucoma in a developing country. *Indian J Ophthalmol.* 2013;61(2):71-73.
44. Mosaed S, Dustin L, Minckler DS. Comparative outcomes between newer and older surgeries for glaucoma. *Trans Am Ophthalmol Soc.* 2009; 107:127-133.
45. Musch DC, Gillespie BW, Niziol LM, et al. Intraocular pressure control and long-term visual loss in the Collaborative Initial Glaucoma Treatment Study. *Ophthalmology.* 2011; 118(9):1766-1773.
46. Neuhann TH. Trabecular micro-bypass stent implantation during small-incision cataract surgery for open-angle glaucoma or ocular hypertension: long-term results. *J Cataract Refract Surg.* 2015; 41:2664-2671.
47. Patel I, de Klerk TA, Au L. Manchester iStent study: early results from a prospective UK case series. *Clin Experiment Ophthalmol.* 2013; 41(7):648-652.

48. Price FW Jr., Wellemeyer M. Long-term results of Molteno implants. *Ophthalmic Surg.* 1995;26(2):130-135.
49. Rulli E, Biagioli E, Riva I, et al. Efficacy and safety of trabeculectomy vs nonpenetrating surgical procedures: a systematic review and meta-analysis. *JAMA Ophthalmol.* 2013; 131(12):1573-1582.
50. Russo V, Scott IU, Stella A, et al. Nonpenetrating deep sclerectomy with reticulated hyaluronic acid implant versus punch trabeculectomy: a prospective clinical trial. *Eur J Ophthalmol.* 2008; 18(5):751-757.
51. Samples JR, Singh K, Lin SC, et al. Laser trabeculoplasty for open-angle glaucoma: A report by the American Academy of Ophthalmology. *Ophthalmology.* 2011;118(11):2296-2302.
52. Samuelson TW, Katz LJ, Wells JM, et al. Randomized evaluation of the trabecular micro-bypass stent with phacoemulsification in patients with glaucoma and cataract. *Ophthalmology.* 2011; 118(3):459-467.
53. Shingleton B, Tetz M, Korber N. Circumferential viscodilation and tensioning of Schlemm canal (canaloplasty) with temporal clear corneal phacoemulsification cataract surgery for open-angle glaucoma and visually significant cataract: one-year results. *J Cataract Refract Surg.* 2008; 34(3):433-440.
54. Smith MF, Doyle JW, Sherwood MB. Comparison of the Baerveldt glaucoma implant with the double-plate Molteno drainage implant. *Arch Ophthalmol.* 1995;113(4):444-447.
55. Spiegel D, Wetzell W, Haffner DS, et al. Initial clinical experience with the trabecular micro-bypass stent in patients with glaucoma. *Adv Ther.* 2007; 24(1):161-170.
56. Tan YL, Chua J, Ho CL. Updates on the surgical management of pediatric glaucoma. *Asia Pac J Ophthalmol (Phila).* 2016;5(1):85-92.
57. Thomas R, Gieser SC, Billson F. Molteno implant surgery for advanced glaucoma. *Aust N Z J Ophthalmol.* 1995;23(1):9-15.
58. Uva MG, Longo A, Reibaldi M. Pneumatic trabeculoplasty versus argon laser trabeculoplasty in primary open-angle glaucoma. *Ophthalmologica.* 2010;224(1):10-15.
59. Wang H, Cheng JW, Wei RL, et al. Meta-analysis of selective laser trabeculoplasty with argon laser trabeculoplasty in the treatment of open-angle glaucoma. *Can J Ophthalmol.* 2013;48(3):186-192.
60. White TC. Aqueous shunt implant surgery for refractory glaucoma. *J Ophthalmic Nurs Technol.* 1996;15(1):7-13.
61. Wilson RP, Cantor L, Katz LJ, et al. Aqueous shunts. Molteno versus Schocket. *Ophthalmology.* 1992;99(5):672-676; discussion 676-678.



62. Yalvac IS, Sahin M, Eksioglu U, et al. Primary viscocanalostomy versus trabeculectomy for primary open-angle glaucoma: three-year prospective randomized clinical trial. *J Cataract Refract Surg.* 2004; 30(10):2050-2057.
63. Zhang ML, Hirunyachote P, Jampel H. Combined surgery versus cataract surgery alone for eyes with cataract and glaucoma. *Cochrane Database Syst Rev.* 2015;7:CD008671.
64. Singh D, Verma A, Singh M. Transciliary filtration for intractable glaucoma. *Trans Ophthalmol. Soc U K.* 1979;99(1):92-95.
65. Singh D, Verma A, Singh M. Transciliary filtration for intractable glaucoma. *Indian J Ophthalmol.* 1981;29(3):157-160.
66. Singh D, Singh, K. Transciliary filtration using the fugo blade. *Ann Ophthalmol.* 2002;34(3):183-187.
67. Lewis RA. Ab interno approach to the subconjunctival space using a collagen glaucoma stent. *J Cataract Refract Surg.* 2014 Aug;40(8):1301-6
68. Galal A, Bilgic A, Eltanamly R, Osman A. XEN Glaucoma Implant with Mitomycin C 1-Year Follow-Up: Result and Complications. *J Ophthalmol.* 2017;2017:5457246.
69. Pérez-torregrosa VT, Olate-pérez Á, Cerdà-ibáñez M, et al. Combined phacoemulsification and XEN45 surgery from a temporal approach and 2 incisions. *Arch Soc Esp Oftalmol.* 2016;91(9):415-21.
70. Olate-pérez Á, Pérez-torregrosa VT, Gargallo-benedicto A, et al. Prospective study of filtering blebs after XEN45 surgery. *Arch Soc Esp Oftalmol.* 2017;
71. Dhalla K, Cousens S, Bowman R, Wood M, Murdoch I. Is Beta Radiation Better than 5-Fluorouracil as an Adjunct for Trabeculectomy Surgery When Combined with Cataract Surgery? A Randomised Controlled Trial. *PLoS ONE.* 2016;11(9):e0161674.
72. Kirwan JF, Rennie C, Evans JR. Beta radiation for glaucoma surgery. *Cochrane Database Syst Rev.* 2009;(2):CD003433.
73. Bussel II, Kaplowitz Z, Schuman JS, Loewen NA; Trabectome Study Group. Outcomes of ab interno trabeculectomy with the trabectome after failed trabeculectomy. *Br J Ophthalmol.* 2015 Feb;99(2):258-62.
74. Hu K, Gazzard G, Bunce C, Wormald R. Ab interno trabecular bypass surgery with Trabectome for open angle glaucoma. *Cochrane Database of Systematic Reviews* 2016, Issue 8. Art. No.: CD011693.
75. Kaplowitz K, Bussel II, Honkanen R, Schuman JS, Loewen NA. Review and meta-analysis of ab-interno trabeculectomy outcomes. *Br J Ophthalmol.* 2016;100(5):594-600.
76. Francis BA, Minckler D, Dustin L, Kawji S, Yeh J, Sit A, Mosaed S, Johnstone M; Trabectome Study Group. Combined cataract extraction and trabeculectomy by the internal approach for

- coexisting cataract and open-angle glaucoma: initial results. *J Cataract Refract Surg.* 2008 Jul;34(7):1096-103.
77. Filippopoulos T, Rhee DJ. Novel surgical procedures in glaucoma: advances in penetrating glaucoma surgery. *Curr Opin Ophthalmol.* 2008 Mar;19(2):149-54.
  78. Pantcheva MB, Kahook MY. Ab interno trabeculectomy. *Middle East Afr J Ophthalmol.* 2010 Oct;17(4):287-9
  79. Carassa RG, Bettin P, Fiori M, Brancato R. Visco canalostomy versus trabeculectomy in white adults affected by open-angle glaucoma: a 2-year randomized, controlled trial. *Ophthalmology.* 2003;110(5):882-7.
  80. Lüke C, Dietlein TS, Jacobi PC, Konen W, Krieglstein GK. A prospective randomized trial of visco canalostomy versus trabeculectomy in open-angle glaucoma: a 1-year follow-up study. *J Glaucoma.* 2002;11(4):294-9.
  81. Jonescu-cuyppers C, Jacobi P, Konen W, Krieglstein G. Primary visco canalostomy versus trabeculectomy in white patients with open-angle glaucoma: A randomized clinical trial. *Ophthalmology.* 2001;108(2):254-8.
  82. Nouredin BN, El-haibi CP, Cheikha A, Bashshur ZF. Visco canalostomy versus trabeculotomy ab externo in primary congenital glaucoma: 1-year follow-up of a prospective controlled pilot study. *Br J Ophthalmol.* 2006;90(10):1281-5.
  83. O'brart DP, Shiew M, Edmunds B. A randomised, prospective study comparing trabeculectomy with visco canalostomy with adjunctive antimetabolite usage for the management of open angle glaucoma uncontrolled by medical therapy. *Br J Ophthalmol.* 2004;88(8):1012-7.
  84. Chai C, Loon SC. Meta-analysis of visco canalostomy versus trabeculectomy in uncontrolled glaucoma. *Glaucoma.* 2010 Oct-Nov;19(8):519-27.
  85. Lichter PR, Musch DC, Gillespie BW, et al; CIGTS Study Group. Interim clinical outcomes in the Collaborative Initial Glaucoma Treatment Study comparing initial treatment randomized to medications or surgery. *Ophthalmology.* 2001;108(11):1943-1953.
  86. McIlraith I, Strasfeld M, Colev G, Hutnik CML. Selective laser trabeculoplasty as initial and adjunctive treatment for open-angle glaucoma. *J Glaucoma.* 2006;15(2):124-30.
  87. Rivier D, Paula JS, Kim E, et al. Glaucoma and keratoprosthesis surgery: Role of adjunctive cyclophotocoagulation. *J Glaucoma* 2009; 18(4):321-324.
  88. Rotchford AP, Jayasawal R, Madhusuhan S, et al. Transscleral diode laser cycloablation in patients with good vision. *Br J Ophthalmol* 2010; 94(9):1180-1183.
  89. Lin SC. Endoscopic and transcleral cyclophotocoagulation for the treatment of refractory glaucoma. *J Glaucoma* 2008; 17(3):238-247

90. Lima FE, Magacho L, Carvalho DM, et al. A prospective, comparative study between endoscopic cyclophotocoagulation and the Ahmed drainage implant in refractory glaucoma. *J Glaucoma* 2004; 13(3):233-237
91. Carter BC, Plager DA, Neely DE, et al. Endoscopic diode laser cyclophotocoagulation in the management of aphakic and pseudophakic glaucoma in children, *J AAPOS* 2007;11(1):34-40
92. Vold, et al. Two-Year COMPASS Trial Results: Supraciliary Microstenting with Phacoemulsification in Patients with Open-Angle Glaucoma and Cataracts. *Ophthalmology*. 2016 Oct;123(10):2103-12.
93. Hoeh, H. et al. Initial Clinical Experience With the CyPass Micro-Stent: Safety and Surgical Outcomes of a Novel Supraciliary Microstent. *J Glaucoma*. 2016 Jan;25(1):106-12.
94. Hoh, S. et al. Two-year clinical experience with the CyPass micro-stent: safety and surgical outcomes of a novel supraciliary micro-stent. *Klin Monbl Augenheilkd*. 2014 Apr;231(4):377-81.
95. Lai JS, Tham CC, Chan JC, et al. Diode laser transscleral cyclophotocoagulation in the treatment of chronic angle-closure glaucoma: a preliminary study. *J Glaucoma* 2003; 12:360-364
96. Yildirim N, Yalvic IS, Sahin A, et al. A comparative study between diode laser cyclophotocoagulation and the Ahmed glaucoma valve implant in neovascular glaucoma: a long-term follow-up. *J Glaucoma* 2009;18:192-196.
97. Kosoko O, Gaasterland DE, Pollack IP et al. Long-term outcome of initial ciliary ablation with contact diode laser transscleral cyclophotocoagulation for severe glaucoma. The Diode Laser Ciliary Ablation Study Group. *Ophthalmology* 1996;103(8): 1294-1302
98. Kirwan JF, Shah P, Khaw PT. Diode laser cyclophotocoagulation: role in the management of refractory pediatric glaucomas. *Ophthalmology* 2002;109(2): 316-323
99. Ocakoglu O, Arslan OS, Kayiran A. Diode laser transscleral cyclophotocoagulation for the treatment of refractory glaucoma after penetrating keratoplasty. *Curr Eye Res* 2005; 30(7):569-574
100. Scholte T, Derse M, Zierhut M. Transscleral diode laser cyclophotocoagulation for the treatment of refractory glaucoma secondary to inflammatory eye diseases. *Br J Ophthalmol* 2000;84(9):999-1003.
101. Kumar A, Dada T, Singh RP, et al. Diode laser trans-scleral cyclphotocoagulation for glaucoma following silicone oil removal. *Clin Experiment Ophthalmol* 2001; 29(4):220-224
102. Berke SJ. Endocyclophotocoagulation in Glaucoma Eds Shaarawy TM, Sherwood MB, Hitchings RA, and Crowston JG. *Glaucoma*. Vol 2. China: Saunders: 2009:(117)591-598.
103. Lin SC. Endoscopic and transcleral cyclophotocoagulation for the treatment of refractory glaucoma. *J Glaucoma* 2008; 17(3):238-247

104. Lima FE, Magacho L, Carvalho DM, et al. A prospective, comparative study between endoscopic cyclophotocoagulation and the Ahmed drainage implant in refractory glaucoma. *J Glaucoma* 2004; 13(3):233-237
105. Neely DE, Plager DA. Endocyclophotocoagulation for management of difficult pediatric glaucomas. *JAAPOS* 2001; 5(4):221-229
106. Nabili S, Kirkness CM. Trans-scleral diode laser cyclophoto-coagulation in the treatment of diabetic neovascular glaucoma. *Eye* 2004; 18(4):352-356
107. Pokroy R, Greenwald Y, Pollack A, et al. Visual loss after diode laser cyclophotocoagulation for primary open-angle and neovascular glaucoma. *Ophthalmic Surg Lasers Imaging* 2008; 39(1):22-29.
108. Bloom PA, Tasi JC, Sharma K, et al. "Cyclodiode". Trans-scleral diode laser cyclophotocoagulation in the treatment of advanced refractory glaucoma. *Ophthalmology* 1997; 104(9):1508-1519.
109. Azuara-Blanco A, Dua HS. Malignant glaucoma after diode laser laser cyclophotocoagulation. *Am J Ophthalmol* 2004; 138(3):403-406. Shen SY, Lai JS, Lam DS. Necrotizing scleritis following diode laser transscleral cyclophotocoagulation. *Ophthalmic Surg Lasers Imaging* 2004; 35(3):251-253.
110. Bechrakis NE, Muller-Stolzenberg NW, Helbig H, Foerster MH. Sympathetic ophthalmia following laser cyclophotocoagulation. *Arch Ophthalmol* 1994; 112(1):80-84.
111. Jonas JB, Back W, Sauder G, et al. Sympathetic ophthalmia in vater association combined persistent hyperplastic primary vitreous after cyclodestructive procedure. *Eur J Ophthalmol* 2006; 16(1):171-172.
112. Chen J, Cohn RA, Lin SC, et al. Endoscopic photocoagulation of the ciliary body for the treatment of refractory glaucomas. *Am J Ophthalmol* 1997; 124(6):787-796.
113. Gayton JL. Traumatic aniridia during endoscopic laser cycloablation. *J Cataract Refract Surg* 1998; 24(1):134-135.
114. Rivier D, Paula JS, Kim E, et al. Glaucoma and keratoprosthesis surgery: Role of adjunctive cyclophotocoagulation. *J Glaucoma* 2009; 18(4):321-324.
115. Rotchford AP, Jayasawal R, Madhusuhan S, et al. Transscleral diode laser cycloablation in patients with good vision. *Br J Ophthalmol* 2010; 94(9):1180-1183.
116. Gayton JL, VanDerKarr M, Sanders V. Combined cataract and glaucoma surgery: Trabeculectomy versus endoscopic laser cycloablation. *J Cataract Refract Surg* 1999; 25:1214-1219.

**Clinical Guideline Revision / History Information**

<b>Original: Review/Revise Dates</b>	<b>Approval Signature/ Title</b>
Original Date: Reviewed/Revised: Signed:	7/31/2017 1/18/2018 Sean Martin, MD, Medical Director