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Aqueous shunts for glaucoma

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[Intervention Review]

Aqueous shunts for glaucoma

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ABSTRACT

Background

Aqueous shunts are employed to control intraocular pressure (IOP) for people with primary or secondary glaucomas who fail or are not candidates for standard surgery.

Objectives

To assess the effectiveness and safety of aqueous shunts for reducing IOP in glaucoma compared with standard surgery, another type of aqueous shunt, or modification to the aqueous shunt procedure.

Search methods

We searched CENTRAL (which contains the Cochrane Eyes and Vision Trials Register) (2016, Issue 8), MEDLINE Ovid (1946 to August 2016), Embase.com (1947 to August 2016), PubMed (1948 to August 2016), LILACS (Latin American and Caribbean Health Sciences Literature Database) (1982 to August 2016), ClinicalTrials.gov (www.clinicaltrials.gov); searched 15 August 2016, and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp/search/en); searched 15 August 2016. We did not use any date or language restrictions in the electronic search for trials. We last searched the electronic databases on 15 August 2016. We also searched the reference lists of identified trial reports and the Science Citation Index to find additional trials.

Selection criteria

We included randomized controlled trials that compared various types of aqueous shunts with standard surgery or to each other in eyes with glaucoma.

Data collection and analysis

Two review authors independently screened search results for eligibility, assessed the risk of bias, and extracted data from included trials. We contacted trial investigators when data were unclear or not reported. We graded the certainty of the evidence using the GRADE approach. We followed standard methods as recommended by Cochrane.

Main results

We included 27 trials with a total of 2099 participants with mixed diagnoses and comparisons of interventions. Seventeen studies reported adequate methods of randomization, and seven reported adequate allocation concealment. Data collection and follow-up times varied.

Four trials compared an aqueous shunt (Ahmed or Baerveldt) with trabeculectomy, of which three reported one-year outcomes. At one-year, the difference in IOP between aqueous shunt groups and trabeculectomy groups was uncertain (mean difference (MD) 2.55 mmHg, 95% confidence interval (CI) -0.78 to 5.87; 380 participants; very low-certainty evidence). The difference in logMAR visual acuity was also uncertain (MD 0.12 units, 95% CI -0.07 to 0.31; 380 participants; very low-certainty evidence). In two trials, the difference in visual field score was uncertain (MD -0.25, 95% CI -1.91 to 1.40; 196 participants; very low-certainty evidence). The mean number of antiglaucoma

medications was higher in the aqueous shunt group than the trabeculectomy group in one trial (MD 0.80, 95% CI 0.48 to 1.12; 184 participants; low-certainty evidence). The effect on needing additional glaucoma surgery was uncertain between groups in two trials (risk ratio (RR) 0.24, 95% CI 0.04 to 1.36; 329 participants; very low-certainty evidence). In one trial, fewer total adverse events were reported in the aqueous shunt group than the trabeculectomy group (RR 0.59, 95% CI 0.43 to 0.81; 212 participants; very low-certainty evidence). No trial reported quality-of-life outcomes at one-year follow-up.

Two trials that compared the Ahmed implant with the Baerveldt implant for glaucoma found higher mean IOP in the Ahmed group at one-year follow-up (MD 2.60 mmHg, 95% CI 1.58 to 3.62; 464 participants; moderate-certainty evidence). The difference in logMAR visual acuity was uncertain between groups (MD -0.07 units, 95% CI -0.27 to 0.13; 501 participants; low-certainty evidence). The MD in number of antiglaucoma medications was within one between groups (MD 0.35, 95% CI 0.11 to 0.59; 464 participants; moderate-certainty evidence). More participants in the Ahmed group required additional glaucoma surgery than the Baerveldt group (RR 2.77, 95% CI 1.02 to 7.54; 514 participants; moderate-certainty evidence). The two trials reported specific adverse events but not overall number of adverse events. Neither trial reported visual field or quality-of-life outcomes at one-year follow-up.

One trial compared the Ahmed implant with the Molteno implant for glaucoma over two-year follow-up. Mean IOP was higher in the Ahmed group than the Molteno group (MD 1.64 mmHg, 95% CI 0.85 to 2.43; 57 participants; low-certainty evidence). The differences in logMAR visual acuity (MD 0.08 units, 95% CI -0.24 to 0.40; 57 participants; very low-certainty evidence) and mean deviation in visual field (MD -0.18 dB, 95% CI -3.13 to 2.77; 57 participants; very low-certainty evidence) were uncertain between groups. The mean number of antiglaucoma medications was also uncertain between groups (MD -0.38, 95% CI -1.03 to 0.27; 57 participants; low-certainty evidence). The trial did not report the proportion needing additional glaucoma surgery, total adverse events, or quality-of-life outcomes.

Two trials compared the double-plate Molteno implant with the Schocket shunt for glaucoma; one trial reported outcomes only at six-month follow-up, and the other did not specify the follow-up time. At six-months, mean IOP was lower in the Molteno group than the Schocket group (MD -2.50 mmHg, 95% CI -4.60 to -0.40; 115 participants; low-certainty evidence). Neither trial reported the proportion needing additional glaucoma surgery, total adverse events, or visual acuity, visual field, or quality-of-life outcomes.

The remaining 18 trials evaluated modifications to aqueous shunts, including 14 trials of Ahmed implants (early aqueous suppression versus standard medication regimen, 2 trials; anti-vascular endothelial growth factor agent versus none, 4 trials; corticosteroids versus none, 2 trials; shunt augmentation versus none, 3 trials; partial tube ligation versus none, 1 trial; pars plana implantation versus conventional implantation, 1 trial; and model M4 versus model S2,1 trial); 1 trial of 500 mm^2 Baerveldt versus 350 mm^2 Baerveldt; and 3 trials of Molteno implants (single-plate with oral corticosteroids versus single-plate without oral corticosteroids, 1 trial; double-plate versus single-plate, 1 trial; and pressure-ridge versus double-plate with tube ligation, 1 trial).

Authors' conclusions

Information was insufficient to conclude whether there are differences between aqueous shunts and trabeculectomy for glaucoma treatment. While the Baerveldt implant may lower IOP more than the Ahmed implant, the evidence was of moderate-certainty and it is unclear whether the difference in IOP reduction is clinically significant. Overall, methodology and data quality among existing randomized controlled trials of aqueous shunts was heterogeneous across studies, and there are no well-justified or widely accepted generalizations about the superiority of one surgical procedure or device over another.

PLAIN LANGUAGE SUMMARY

Aqueous shunts for glaucoma

What was the aim of this review?
We aimed to learn:
1. how successful and safe aqueous shunts are for lowering eye pressure when compared with standard surgery (trabeculectomy);
2. how successful and safe various types of aqueous shunts are when compared with each other; and
3. how successful and safe aqueous shunts are when the procedure is modified.

Our search for relevant studies identified 27 trials.

Key messages
It is uncertain if aqueous shunts are more effective or are safer than standard surgery (trabeculectomy) for glaucoma (very low-certainty evidence). The Baerveldt and Molteno aqueous shunts may reduce eye pressure more than the Ahmed shunt (moderate- and low-certainty evidence).

What did we study in this review?
Glaucoma is a condition caused by the build-up of fluid in the front part of the eye. This build-up of fluid raises the eye pressure, which can lead to damage of the optic nerve and vision loss. Some people with glaucoma need surgery to reduce eye pressure. Standard surgery is called trabeculectomy. In trabeculectomy, a small hole is made to the tissue in the front of the eye to create a drain for the fluid. Alternatively, a small implant called an aqueous shunt can be inserted into the eye to create a pathway for fluid to drain.

What were the main results of this review?

We found 27 studies. Four studies compared an aqueous shunt (either Ahmed or Baerveldt) with standard surgery (trabeculectomy). Five trials compared two different types of shunt (Ahmed versus Baerveldt, Ahmed versus Molteno, Molteno versus Schocket). Eighteen studies compared modifications to aqueous shunts.

The results of the review were as follows.

1. The evidence comparing aqueous shunts with trabeculectomy was of very low-certainty.
2. There were some differences between different implants: the Baerveldt and Molteno implants may work better than the Ahmed implant; eye pressure was reduced more and fewer antiglaucoma medications were needed (moderate- and low-certainty evidence). The Molteno implant may work better than the Schocket implant (low-certainty evidence on eye pressure only).
3. Although 18 trials looked at modifications to aqueous shunts, many different modifications were studied, and the evidence was inconclusive.

How up-to-date is this review?

We searched for studies that had been published up to 15 August 2016.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Aqueous shunts versus trabeculectomy

Aqueous shunts compared with trabeculectomy for glaucoma

Population: People with glaucoma

Settings: Glaucoma surgery

Intervention: Aqueous shunt (Ahmed or Baerveldt)

Comparison: Trabeculectomy

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk: Trabeculectomy	Corresponding risk: Aqueous shunt				
Mean IOP at 1-year follow-up	The mean IOP ranged across trabeculectomy groups from 11.4 mmHg to 13.8 mmHg.	The mean IOP in the aqueous shunt groups was **2.55 mmHg higher** (0.78 lower to 5.87 mmHg higher).	**MD 2.55 mmHg** (-0.78 mmHg to 5.87 mmHg)	380 (3 studies)	⊕⊖⊖⊖ **very low[1,2,3]**	
Mean logMAR visual acuity at 1-year follow-up	The mean change in logMAR visual acuity ranged across trabeculectomy groups from -0.29 units to 5.77 units.	The mean logMAR visual acuity in the aqueous shunt groups was **0.12 units higher** (0.07 units lower to 0.31 units higher).	**MD 0.12 units** (-0.07 units to 0.31 units)	380 (3 studies)	⊕⊖⊖⊖ **very low[1,2,3]**	
Mean change in visual field score from baseline at 1-year follow-up	The mean change in visual field score ranged across trabeculectomy groups from 0.09 to 1.09.	The mean change in visual field score in the aqueous shunt groups was **0.25 lower** (1.91 lower to 1.40 higher).	**MD -0.25** (-1.91 to 1.40)	196 (2 studies)	⊕⊖⊖⊖ **very low[1,3,4]**	1 trial did not report visual field outcomes.
Mean number of antiglaucoma medications at 1-year follow-up	The mean number of antiglaucoma medications in the trabeculectomy group was 0.5.	The mean number of antiglaucoma medications in the aqueous shunt group was **0.80 higher** (0.48 to 1.12 higher).	**MD 0.80** (0.48 to 1.12)	184 (1 study)	⊕⊕⊖⊖ **low[1,4]**	2 trials reported that the mean number of antiglaucoma medications was higher in the aqueous shunt group than in the trabeculectomy group, but reported insufficient data for analysis.

Proportion needing additional glaucoma surgery at 1-year follow-up	**36 per 1000**	**9 per 1000** (1 to 49)	**RR 0.24** (0.04 to 1.36)	329 (2 studies)	⊕⊖⊖⊖ **very low**[1,2,3]	1 trial reported reoperation data at 4 years' follow-up only.
Adverse events up to 1-year follow-up	**571 per 1000**	**337 per 1000** (246 to 463)	**RR 0.59** (0.43 to 0.81)	212 (1 study)	⊕⊖⊖⊖ **very low**[1,2,3]	2 trials reported specific adverse events (e.g. flat anterior chamber, choroidal effusion, hyphema), but not overall number of adverse events.
Quality of life at 1-year follow-up	Not reported	Not reported	-	-	-	

*The basis for the **assumed risk** is the mean control group risk across studies. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% confidence interval).
CI: confidence interval; **IOP:** intraocular pressure; **MD:** mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate certainty: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low certainty: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low certainty: We are very uncertain about the estimate.

[1]Downgraded (-1) for high or unclear risk of bias among included trials.
[2]Downgraded (-1) for heterogeneity or inconsistency across trials.
[3]Downgraded (-1) for imprecision of results (wide confidence intervals).
[4]Downgraded (-1) for high probability of publication bias (selectively not reported from included trials).

Summary of findings 2. Ahmed implant versus Baerveldt implant

Ahmed implant compared with Baerveldt implant for glaucoma

Population: People with glaucoma

Settings: Glaucoma surgery

Intervention: Ahmed implant

Comparison: Baerveldt implant (350 mm^2)

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk: Baerveldt implant	Corresponding risk: Ahmed implant				
Mean IOP at 1-year follow-up	The mean IOP ranged across Baerveldt implant groups from 13.2 mmHg to 13.6 mmHg.	The mean IOP in the Ahmed implant groups was **2.60 mmHg higher** (1.58 mmHg to 3.62 mmHg higher).	**MD 2.60 mmHg** (1.58 mmHg to 3.62 mmHg)	464 (2 studies)	⊕⊕⊕⊖ **moderate**[1]	
Mean logMAR visual acuity at 1-year follow-up	The mean logMAR visual acuity ranged across Baerveldt implant groups from 1.23 to 1.5 logMAR units.	The mean logMAR visual acuity in the Ahmed implant groups was **0.07 units lower** (0.27 units lower to 0.13 units higher).	**MD -0.07 units** (-0.27 units to 0.13 units)	501 (2 studies)	⊕⊕⊖⊖ **low**[1,2]	
Mean change in visual field score from baseline at 1-year follow-up	Not reported	Not reported	-	-	-	
Mean number of antiglaucoma medications at 1-year follow-up	The mean number of antiglaucoma medications ranged across Baerveldt implant groups from 1.2 to 1.5.	The mean number of antiglaucoma medications in the Ahmed implant groups was **0.35 higher** (0.11 to 0.59 higher).	**MD 0.35** (0.11 to 0.59)	464 (2 studies)	⊕⊕⊕⊖ **moderate**[1]	
Proportion needing additional glaucoma surgery at 1-year follow-up	**20 per 1000**	**56 per 1000** (21 to 153)	**RR 2.77** (1.02 to 7.54)	514 (2 studies)	⊕⊕⊕⊖ **moderate**[1]	
Adverse events up to 1-year follow-up	See comment	See comment	-	-	-	The 2 trials reported specific adverse events (e.g. flat anterior chamber, choroidal effusion, hyphema), but not overall number of adverse events.
Quality of life at 1-year follow-up	Not reported	Not reported	-	-	-	

*The basis for the **assumed risk** is the mean control group risk across studies. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% confidence interval).

CI: confidence interval; **IOP:** intraocular pressure; **MD:** mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate certainty: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low certainty: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low certainty: We are very uncertain about the estimate.

[1]Downgraded (-1) for high or unclear risk of bias among included trials.
[2]Downgraded (-1) for imprecision of results (wide confidence intervals).

Summary of findings 3. Ahmed implant versus Molteno implant

Ahmed implant compared with Molteno implant for glaucoma

Population: People with glaucoma

Settings: Glaucoma surgery

Intervention: Ahmed implant

Comparison: Molteno implant (single-plate)

Outcomes*	Illustrative comparative risks** (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk: Molteno implant	Corresponding risk: Ahmed implant				
Mean IOP at 1-year follow-up	The mean IOP in the Molteno implant group was 15.36 mmHg.	The mean IOP in the Ahmed implant group was **1.64 mmHg higher** (0.85 mmHg to 2.43 mmHg higher).	**MD 1.64 mmHg** (0.85 mmHg to 2.43 mmHg)	57 (1 study)	⊕⊕⊖⊖ **low[1,2]**	
Mean logMAR visual acuity at 1-year follow-up	The mean logMAR visual acuity in the Molteno implant group was 0.7 units.	The mean logMAR visual acuity in the Ahmed implant group was **0.08 units higher** (0.24 units lower to 0.40 units higher).	**MD 0.08 units** (-0.24 units to 0.40 units)	57 (1 study)	⊕⊖⊖⊖ **very low[1,2,3]**	
Mean change in visual field score from baseline at 1-year follow-up	The mean deviation in Humphrey visual fields in the Molteno implant group was -19.49 dB.	The mean deviation in Humphrey visual fields in the Ahmed implant group was **0.18 dB lower** (3.13 dB lower to 2.77 dB higher).	**MD -0.18 dB** (-3.13 dB to 2.77 dB)	57 (1 study)	⊕⊖⊖⊖ **very low[1,2,3]**	

Mean number of antiglaucoma medications at 1-year follow-up	The mean number of antiglaucoma medications in the Molteno implant group was 1.41.	The mean number of antiglaucoma medications in the Ahmed implant group was **0.38 lower** (1.03 lower to 0.27 higher).	**MD -0.38** (-1.03 to 0.27)	57 (1 study)	⊕⊕⊖⊖ **low[1,2]**	
Proportion needing additional glaucoma surgery at 1-year follow-up	Not reported	Not reported	-	-	-	
Adverse events up to 1-year follow-up	See comment	See comment	-	-	-	The trial reported specific adverse events (e.g. flat anterior chamber, choroidal effusion, hyphema), but not overall number of adverse events.
Quality of life at 1-year follow-up	Not reported	Not reported	-	-	-	

*The primary follow-up time for this review was 1 year, however the trial comparing Ahmed versus Molteno implants reported data at 2 years only.
The basis for the **assumed risk is the mean control group risk across studies. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% confidence interval).
CI: confidence interval; **IOP:** intraocular pressure; **MD:** mean difference

GRADE Working Group grades of evidence
High certainty: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate certainty: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low certainty: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low certainty: We are very uncertain about the estimate.

[1]Downgraded (-1) for high or unclear risk of bias among included trials.
[2]Downgraded (-1) for indirectness (follow-up time was 2 years).
[3]Downgraded (-1) for imprecision (wide confidence intervals).

Summary of findings 4. Molteno implant versus Schocket shunt

Molteno implant compared with Schocket shunt for glaucoma

Population: People with glaucoma

Settings: Glaucoma surgery

Intervention: Molteno implant (double-plate)

Comparison: Schocket shunt

Outcomes*	Illustrative comparative risks** (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk: Schocket shunt	Corresponding risk: Molteno implant				
Mean IOP at 1-year follow-up	The mean IOP in the Schocket shunt group was 18.9 mmHg.	The mean IOP in the Molteno implant group was **2.50 mmHg lower** (4.60 mmHg to 0.40 mmHg lower).	**MD -2.50 mmHg** (-4.60 mmHg to -0.40 mmHg)	115 (1 study)	⊕⊕⊖⊖ **low**[1,2]	Another trial reported mean IOP for 40 participants (19 in the Molteno group and 21 in the Schocket shunt group), but did not report the follow-up time at which data were collected.
Mean logMAR visual acuity at 1-year follow-up	Not reported	Not reported	-	-	-	
Mean change in visual field score from baseline at 1-year follow-up	Not reported	Not reported	-	-	-	
Mean number of antiglaucoma medications at 1-year follow-up	See comment	See comment	-	-	-	1 trial reported the number of antiglaucoma medications for 40 participants (19 in the Molteno group and 21 in the Schocket shunt group), but did not report the follow-up time at which data were collected. Another trial did not report this outcome.
Proportion needing additional glaucoma surgery at 1-year follow-up	Not reported	Not reported	-	-	-	
Adverse events up to 1-year follow-up	See comment	See comment	-	-	-	1 trial reported specific adverse events (e.g. flat anterior chamber, choroidal effusion, hyphema), but not overall number of ad-

						verse events. Another trial did not report adverse events.
Quality of life at 1-year follow-up	Not reported	Not reported	-	-	-	

*The primary follow-up time for this review was 1 year, however the trial comparing Molteno implant versus Schocket shunt reported data at 6 months only.
The basis for the **assumed risk is the mean control group risk across studies. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% confidence interval).
CI: confidence interval; **IOP:** intraocular pressure; **MD:** mean difference

GRADE Working Group grades of evidence
High certainty: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate certainty: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low certainty: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low certainty: We are very uncertain about the estimate.

[1]Downgraded (-1) for high or unclear risk of bias among included trials.
[2]Downgraded (-1) for indirectness (follow-up time was 6 months).

BACKGROUND

Description of the condition

Glaucoma is an important cause of chronic visual loss and the second-leading cause of blindness worldwide. It is estimated that there will be 79.6 million people with glaucoma worldwide by the year 2020 (Quigley 2006). Glaucoma is characterized by a chronic progressive optic neuropathy with characteristic patterns of visual field loss, and it is diagnosed by a combination of features of the ophthalmological examination and ancillary testing. The visual field loss from glaucoma leads to eventual blindness if left untreated (Congdon 2004). Elevated intraocular pressure (IOP) is a central risk factor for glaucoma. Additional risk factors include older age, African-American ethnicity, family history of glaucoma, low ocular perfusion pressure, myopia, and diabetes mellitus. Studies have demonstrated that lowering IOP decreases the risk of visual loss in glaucoma and prevents the eventual loss of functional vision (CNTGSG 1998a; CNTGSG 1998b; Gordon 2002; Heijl 2002; Leske 2003). Accordingly, several mainstays of treatment for glaucoma, which include medications, lasers, and surgery, are targeted at lowering IOP.

Description of the intervention

Aqueous shunts are employed as surgical interventions to control IOP in people with advanced glaucoma who fail standard surgery with trabeculectomy, or in people with glaucoma subtypes where trabeculectomy is unlikely to succeed (AAO 2010). All aqueous shunts considered in this review are composed of a lumened silicone rubber tube attached to an explant plate. The Molteno implant was the first widely utilized aqueous shunt (Molteno 1981; Molteno 2001; Molteno 2003). Newer shunts such as the Ahmed and Baerveldt implants have features in common with the Molteno, but vary in size, shape, composition, and the presence or absence of flow-restricting devices for IOP regulation (Prata 1996). The Ahmed implant is available in either rigid (polymethylmethracylate) or flexible (silicone rubber) versions in one or two plate models, and contains a flow-restricting valve designed to prevent postoperative hypotony (Huang 1999). It has been suggested that silicone Ahmed implants may be associated with more effective IOP control but a potentially higher rate of complications compared with polymethylmethracylate implants (Law 2005). The Baerveldt implant consists of a single plate without a flow-restricting mechanism; intraoperative tube ligation is thus required for formation of a mature space for fluid absorption (Britt 1999; Krishna 2001). The Schocket shunt, assembled intraoperatively, utilizes retinal buckling elements and a segment of silicone rubber tubing, and is similar to commercially available devices (Schocket 1982; Sidoti 1994). The OptiMed, White shunt pump, Joseph implant, and Krupin valve are not in current use.

Ab-interno procedures that do not require scleral dissection, such as trabectome or implantation of the iStent (Glaukos Corp., Laguna Hills, CA), are not covered under the scope of this review. Modified trabeculectomies in which devices are used to control outflow or to modify healing and promote continued drainage from the anterior chamber are not considered aqueous shunts for the purposes of this review. A separate Cochrane review identified low-certainty evidence suggesting that these devices used with standard trabeculectomies may help reduce IOP (Wang 2015). Examples of these modified trabeculectomies include the EX-PRESS shunt, Ologen implant, SKgel implant, and T-flux implant. This review also did not discuss current exploration of aqueous drainage into the suprachoroidal space, such as with the Gold Shunt (SOLX Inc., Boston, MA) or the CyPass shunt (Transcend Medical, Menlo Park, CA).

Epidemiology

The use of aqueous shunts is increasing. A study of Medicare fee-for-service data reported that the number of aqueous shunt procedures in Medicare increased 184% from 2728 procedures in 1995 to 7744 procedures in 2004. Conversely, the number of trabeculectomies decreased 53% from 51,690 procedures in 1995 to 24,178 procedures in 2004 (Ramulu 2007). Additionally, surveys of members of the American Glaucoma Society found that in eight clinical situations (previous failed trabeculectomy, previous intra- or extracapsular cataract extraction, previous phacoemulsification, previous penetrating keratoplasty, previous scleral buckle, previous pars plana vitrectomy, uveitic glaucoma, neovascular glaucoma), aqueous shunts were the primary surgical choice to lower IOP for 17.5% of members in 1996 versus for 50.6% of members in 2008 (Desai 2011; Joshi 2005). There are no data tracking the utilization patterns of aqueous shunts with regard to age, sex, or race, but it has been suggested that they will be applied increasingly to complex glaucomas and for combined procedures at an earlier stage among patients of all ages and races (Hoffman 2002). Commercially available aqueous shunts cost between USD 400 and USD 600, in addition to surgeon fees and other costs associated with surgery.

Indications for use

In the USA, the majority of adult eyes in which aqueous shunts are currently used are pseudophakic (Mills 1996; Minckler 1988), though small-incision cataract surgery has been performed in eyes with pre-existing aqueous shunts with maintenance of IOP control (Gujral 2005). Aqueous shunts are mainly recommended for people with advanced glaucoma for whom trabeculectomy has failed, and for neovascular, post-traumatic, and inflammatory glaucomas where trabeculectomy is likely to fail (AAO 2010). Additionally, they are used in congenital glaucomas that fail goniotomy or trabeculectomy (Djodeyre 2001), and they have been demonstrated retrospectively to have moderate long-term success in pediatric patients with both one and two shunts (Chen 2015; Ou 2009). Aqueous shunts are also used to manage glaucoma in complex cases where penetrating keratoplasty and retina-vitreous surgery may be simultaneously or serially performed (Lloyd 1989). Aqueous shunts may be preferable to trabeculectomy with adjunctive antifibrotic agents in people who work in dusty or dirty environments or who require contact lenses for functional vision or in those who are immunocompromised, as the risk of late infection may be less.

Flow-restricted devices (Ahmed, Krupin, White shunt pump, Joseph implant, OptiMed) have typically been installed in one stage (complete installation) with immediate function. Non-flow-restricted devices (Molteno, Baerveldt) are typically installed with utilization of a variety of temporary flow-restricting techniques. With all of these devices, the location of anterior edge of the explant plate depends on the quadrant in which the device is implanted (Minckler 1988; Prata 1995a; Prata 1995b). The delay in the opening of the non-flow-restricted shunts is designed to allow encapsulation to develop over the explant before flow of aqueous humor begins in order to reduce the risk of postoperative

hypotony, but this delay can create difficulties with IOP control while encapsulation is developing.

How the intervention might work

Aqueous shunts may prevent or delay blindness and visual disability in eyes with advanced or complicated glaucomas. Aqueous shunts are currently the standard of care in the USA for complicated glaucomas, especially in pseudophakic eyes that have failed one or more previous trabeculectomies. The long-term outcome for aqueous shunts has not been well studied, but some reports indicate that IOP control benefits may extend for several decades (Molteno 2001; Molteno 2003). In general, the failure rates per year parallel those of trabeculectomy in similar cases (FFSSG 1996), though trabeculectomy may be more effective when lower IOP levels are needed (Tran 2009). A previous case control study suggested that Ahmed and Baerveldt implants may have similar efficacy for glaucoma treatment (Syed 2004), though aqueous shunts may be more likely to fail overall in people with a history of glaucoma surgery (Souza 2007).

The principal long-term complication of anterior chamber aqueous shunts is corneal endothelial decompensation. Postoperative hypotony also can occur, likely due to leaking around the tube in limbal tissues or failure of flow-restricting devices to maintain sufficient resistance. Several reports have described a postoperative hypertensive phase that necessitates resumption of topical antiglaucoma medications for many weeks, though it has been suggested that early initiation of postoperative aqueous suppression may improve long-term IOP control (Law 2016). Postoperative dynamic movement of the Ahmed valve has also been reported and is likely due to long-term dissociation of the fibrovascular capsule and the valve plate from rotation of the globe (Law 2009). Clinical failure is in many cases due to excessive fibrosis and relative impermeability of the capsule around the explant. Comorbidities, which include optic nerve injury, corneal disease, or other damage related to past trauma or previous surgery, are frequently present in eyes in which shunts are employed. Aqueous shunts likely increase the risk of endothelial failure, and they are widely thought to increase the risk of graft failure after penetrating keratoplasty, especially with the drainage tube installed in the anterior chamber (Hollander 2010).

Why it is important to do this review

Since the publication of the original Cochrane review of aqueous shunts in 2006 (Minckler 2006), multiple randomized trials have been conducted examining the effectiveness of aqueous shunts versus trabeculectomy and of Ahmed versus Baerveldt implants for glaucoma management. Most surgeons in the USA reserve aqueous shunts until one or more standard procedures have failed, and controversy persists regarding when aqueous shunts should be used in the sequence of glaucoma surgeries as well as the effectiveness of different aqueous shunts. The importance of aqueous shunts has grown substantially in the last few decades in many areas of the world as lifespan has increased and larger numbers of people with advanced glaucoma require vision-sustaining therapies beyond traditional medical and surgical treatments.

OBJECTIVES

To assess the effectiveness and safety of aqueous shunts for reducing IOP in glaucoma compared with standard surgery, another type of aqueous shunt, or modification to the aqueous shunt procedure.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomized controlled trials only.

Types of participants

We included trials in which the participants were diagnosed with glaucoma irrespective of their lens status. There were no restrictions with regard to participant age, gender, ethnicity, comorbidities, use of adjunctive medications, or the number of participants.

Types of interventions

We included all trials that compared various aqueous shunts with standard surgery or to each other, though this review mainly focused on comparisons of aqueous shunts versus standard surgery and comparisons of different types of aqueous shunts with each other. Comparisons of the same aqueous shunt with versus without modifications were of secondary importance. We did not include trials that compared different surgical techniques with the use or non-use of antifibrotic agents, as these comparisons will be examined in a separate Cochrane review (Foo 2015). We also did not include trials that compared different surgical techniques with cyclodestructive procedures, as these comparisons will be examined in separate Cochrane reviews (Chen 2016; Jones 2011).

We assessed the following three comparisons in this review.

- Aqueous shunts compared with trabeculectomy
- Aqueous shunts compared with another aqueous shunt
- Aqueous shunts compared with and without modification

Types of outcome measures

Primary outcomes

1. Control of IOP assessed as:
   a. mean decrease from baseline (immediate preoperative IOP) measured using Goldmann tonometry, Tono-Pen, or other standard device.
   b. proportion meeting IOP thresholds defined as:
      i. threshold A: final IOP ≤ 21 mmHg and one or more of (1) ≥ 15% reduction of IOP or (2) reduction of at least two medications;
      ii. threshold B: final IOP ≤ 18 mmHg and one or more of (1) ≥ 20% reduction of IOP or (2) reduction of at least two medications;
      iii. threshold C: final IOP ≤ 15 mmHg and one or more of (1) ≥ 25% reduction of IOP or (2) reduction of at least two medications;
      iv. threshold D: final IOP ≤ 12 mmHg and one or more of (1) ≥ 30% reduction of IOP or (2) reduction of at least two medications.

For all threshold criteria, we required the final IOP to be less than or equal to the baseline IOP. We revised IOP threshold definitions from the original review based on more stringent and detailed criteria reported by multiple studies, and utilized both numerical IOP value and percentage decrease in IOP to define thresholds (Alvarado 2008; Fontana 2006a; Fontana 2006b; Jampel 2012; Supawavej 2013; Tran 2009).

Secondary outcomes

1. Visual acuity as available throughout follow-up and at last follow-up as measured by any method. We did not include visual acuity as a primary outcome as it is not uncommon to observe visual acuity better than 20/40 in people who are functionally and legally blind from glaucoma due to severe loss of vision outside the fixational area.
2. The time to onset and duration of a recognizable postoperative hypertensive phase.
3. Visual field as available throughout follow-up and at last follow-up as measured by any method.
4. Total number of antiglaucoma medications, both topical and systemic, as adjuncts to surgery at variable lengths of follow-up. Number of glaucoma medications was a continuous outcome and reported as mean with standard deviation.
5. Need for additional glaucoma surgery after aqueous shunt placement.

Adverse events

Surgical complications during follow-up, including but not limited to:

- corneal injury (endothelial decompensation/edema);
- suprachoroidal hemorrhage;
- retinal detachment;
- cataract;
- hypotony;
- infection;
- strabismus;
- host-immune response to anterior chamber tubes (keratic precipitates);
- clinical failure;
- late hypotony;
- late wound leaks;
- late failure due to vitreous or fibrin plugging of tubes including pars plana installations in postvitrectomy eyes.

Quality of life

We summarized and compared data on quality of life when available from the included studies.

Follow-up

We placed no restrictions on the duration of follow-up. The primary follow-up time point was one year after surgery. We also considered time points at postoperative month six and years two, three, and five.

Search methods for identification of studies

Electronic searches

The Cochrane Eyes and Vision Information Specialist conducted systematic searches in the following databases. There were no study design, language, or publication year restrictions. The date of the search was 15 August 2016.

- Cochrane Central Register of Controlled Trials (CENTRAL; 2016, Issue 8) (which contains the Cochrane Eyes and Vision Trials Register) in the Cochrane Library (searched 15 August 2016) (Appendix 1)
- MEDLINE Ovid (1946 to 15 August 2016) (Appendix 2)
- Embase.com Ovid (1947 to 15 August 2016) (Appendix 3)
- PubMed (1948 to 15 August 2016) (Appendix 4)
- LILACS (Latin American and Caribbean Health Science Information Database) (1982 to 15 August 2016) (Appendix 5)
- US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov (www.clinicaltrials.gov; searched 15 August 2016) (Appendix 6)
- World Health Organization International Clinical Trials Registry Platform (www.who.int/ictrp; searched 15 August 2016) (Appendix 7)

Searching other resources

We searched the reference lists of identified trial reports to find additional trials. We used the Science Citation Index to find studies that cited the identified trials. We did not conduct manual searches of conference proceedings or abstracts specifically for this review.

Data collection and analysis

Selection of studies

Two review authors independently assessed the titles and abstracts of all records identified by the electronic and manual searches as per the Criteria for considering studies for this review. We classified each record as (a) relevant, (b) possibly relevant, or (c) definitely not relevant; a third review author resolved any disagreements. We obtained full copies of those records classified as (a) relevant or (b) possibly relevant and grouped reports by study. Two review authors independently classified each study as (1) included, (2) awaiting assessment, or (3) excluded; a third review author resolved any disagreements. We listed eligible studies identified as included but not yet completed as ongoing studies. We attempted to contact primary investigators for clarification of studies classified as awaiting assessment. We documented studies excluded after review of the full text with reasons for exclusion. The review authors were unmasked to the report authors, institutions, and trial results during this assessment. For reports written in languages not read by the review authors, we collaborated with colleagues to assist with screening and to translate the reports when needed.

Data extraction and management

Two review authors independently abstracted from each study data related to study design, methods, participants, interventions, and outcomes onto paper data collection forms developed by the Cochrane Eyes and Vision Group. The forms were pilot tested on two trials, and the revised form was used to extract data from the included trials. We resolved any discrepancies by discussion. We attempted to contact primary investigators when data were unclear

or not reported. Wherever possible, and for included trials for which the investigators were unable to provide us with the data, we extracted data from figures in the published papers. We extracted the mean IOP values when mean change in IOP was not available. When success in IOP control was analyzed with Kaplan-Meier or life table analyses, we tried to extract data on log-hazard ratios either through log-rank statistics or through published Kaplan-Meier curves if time points for losses to follow-up were mentioned. One review author entered data into Review Manager 5 (Review Manager 5 2014), and a second review author verified the data entry.

Assessment of risk of bias in included studies

Two review authors assessed trials according to methods set out in Chapter 8 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We considered the following parameters: method of sequence generation and concealment of allocation (selection bias), masking of outcome assessors (detection bias), rates of follow-up and intention-to-treat analysis (attrition bias), selective reporting bias, and other potential sources of bias, such as funding source. Masking of investigators during clinical trials comparing aqueous shunts with other methods of glaucoma surgery would not be possible, as the presence of an anterior chamber or vitreous tube or standard filtering bleb would be obvious to any observer. Hence we did not assess masking of care providers or participants (performance bias) as 'Risk of bias' criteria in this review.

Two review authors independently graded each 'Risk of bias' parameter as low risk, unclear risk, or high risk of bias. We attempted to contact primary investigators when study methods were unclear or not reported. A third review author resolved any disagreements.

Measures of treatment effect

For dichotomous outcomes we calculated risk ratios with 95% confidence intervals. Dichotomous outcomes included the proportion meeting certain IOP thresholds, the proportion undergoing additional glaucoma surgery, and the proportion with adverse events.

We calculated mean differences with 95% confidence intervals for continuous outcomes, which included mean postoperative IOP, mean logMAR visual acuity, mean change in visual field score, and mean number of antiglaucoma medications. We planned to measure quality of life outcomes as continuous outcomes when available.

We planned to calculate hazard ratios for outcomes related to the time to onset and duration of a recognizable postoperative hypertensive phase; however, sufficient data for analysis were not reported for these outcomes in any of the included trials.

Unit of analysis issues

The unit of analysis was the individual (one study eye per person).

Dealing with missing data

In instances when data were not reported or unclear, we attempted to contact primary study investigators for supplemental information or clarification of reported results. We allowed a six-week response time, or else we used the available data. We did not impute data for the purposes of this review.

Assessment of heterogeneity

We assessed for methodological and clinical heterogeneity by comparing study designs, participants, interventions, and outcomes across studies. When we identified no methodological or clinical heterogeneity, we combined quantitative outcome data and examined the I^2 value and tested for statistical heterogeneity using the Chi^2 test. We considered an I^2 value greater than 60% to represent substantial statistical heterogeneity and a Chi^2 P value greater than 0.1 to represent significant statistical heterogeneity.

Assessment of reporting biases

To assess selective reporting bias, we compared prespecified outcomes in study protocols and trial registry records, when available, with outcomes reported in published manuscripts. When protocols and trial registry records were not available, we compared outcomes specified in the Methods section of the manuscript with those that were described in the Results. As there was an insufficient number of studies included in each meta-analysis (fewer than 10), we did not use funnel plots to assess publication bias.

Data synthesis

Data analysis followed the guidelines in Chapter 9 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011). When we detected no heterogeneity among trials, we combined the results in a meta-analysis. We planned to use a random-effects model when three or more trials were included in a meta-analysis and a fixed-effect model when fewer than three trials were included in a meta-analysis. As all meta-analyses included fewer than three trials, we used a fixed-effect model for all analyses.

Subgroup analysis and investigation of heterogeneity

We performed no subgroup analyses by glaucoma subtype or number of previous surgeries due to marked variability in data reporting. In cases of clinical or statistical heterogeneity we did not combine study results, but presented a narrative summary.

Sensitivity analysis

There were an insufficient number of studies to perform sensitivity analyses.

Summary of findings

We reported effect estimates for our main comparisons in 'Summary of findings' tables. We used the GRADE system to judge the certainty of evidence for each outcome (GRADEpro 2014; Guyatt 2011). We included prespecified outcomes at one year of follow-up that included IOP, logMAR visual acuity, number of antiglaucoma medications, visual field mean deviation, need for reoperation to control glaucoma progression, and complications.

RESULTS

Description of studies

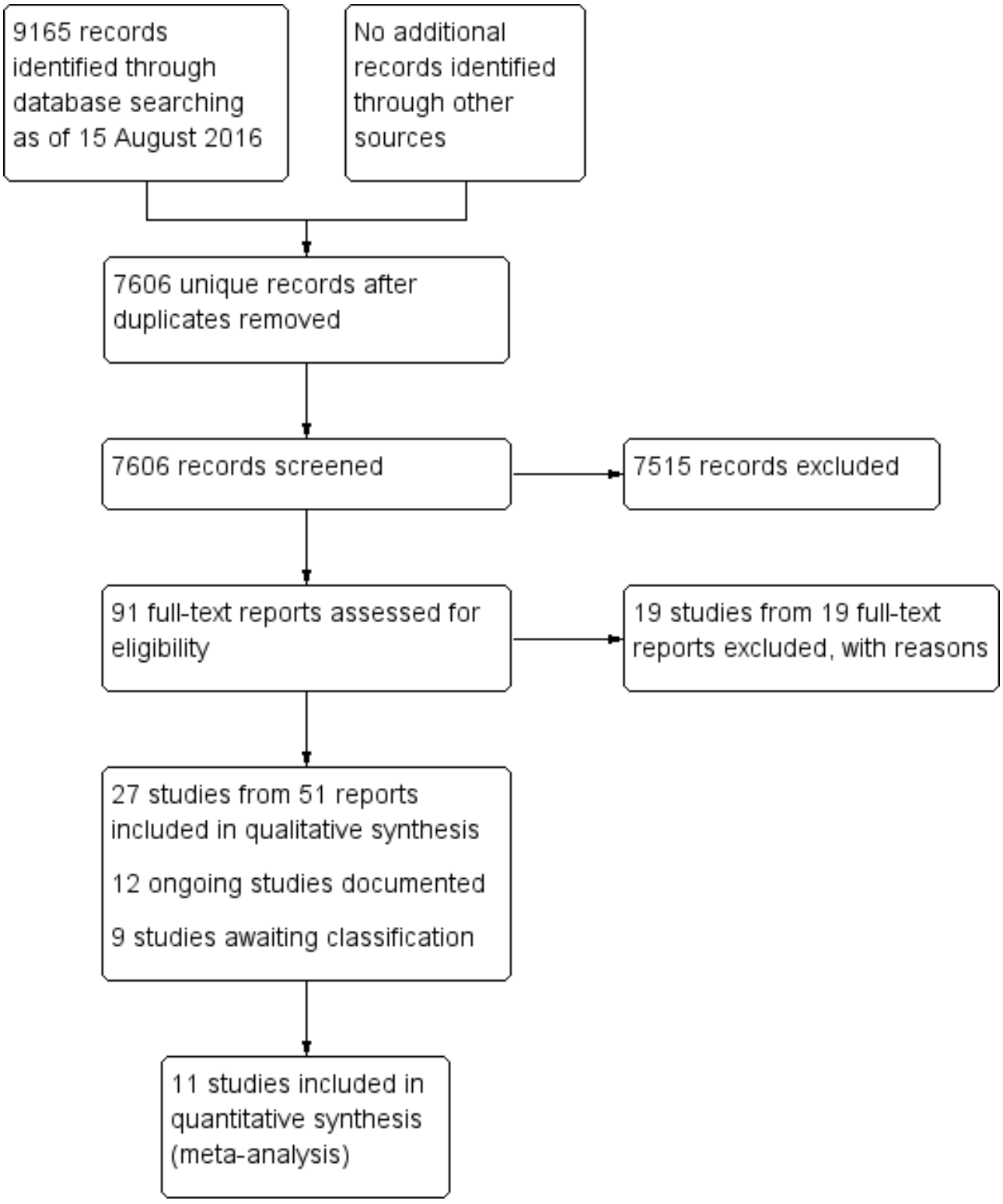
Results of the search

This review is an update of a previously published Cochrane review; however, as we have updated the search strategy and modified the

eligibility criteria (Differences between protocol and review), we executed the new search without date restrictions and screened all search results according to the Criteria for considering studies for this review.

The electronic searches as of 15 August 2016 yielded 7606 unique records (5453 from bibliographic databases and 2153 from clinical trial registers) (Figure 1). Of these records, we determined 91 to be relevant or potentially relevant. We included 27 studies (from 51 reports), excluded 19 studies, classified 12 studies as ongoing, and require further clarification for 9 studies. We will update the review with additional information as it becomes available.

Figure 1. Study flow diagram.



Included studies

The following is a concise summary of the salient features of the 27 included studies. A detailed description of each trial is presented in the Characteristics of included studies table.

Types of participants

The trials enrolled a total of 2099 participants. Most trials enrolled adults only, though Pakravan 2007 examined children with pediatric aphakic glaucoma. Three studies included only participants with neovascular glaucoma (Arcieri 2015; Mahdy

2013; Teixeira 2012), while the remainder of studies included a combination of glaucoma subtypes. The smallest trial enrolled 11 participants (Desai 2013), and the largest trial enrolled 276 participants (ABC 2011).

Types of interventions

The included studies compared a wide variety of interventions (Table 1). We considered three main comparisons for analysis as described in the Methods section.

Aqueous shunts compared with trabeculectomy (4 trials)

Three trials compared the Ahmed implant with trabeculectomy, though two trials focused on adults with primary open- or closed-angle glaucoma (Wilson 2000; Wilson 2003), and one trial focused on children with pediatric aphakic glaucoma (Pakravan 2007). One trial compared the Baerveldt implant with trabeculectomy in eyes with glaucoma that had a previous trabeculectomy or cataract surgery (TVT 2009).

Aqueous shunts compared with another aqueous shunt (5 trials)

Two trials compared the Ahmed implant with the Baerveldt implant (ABC 2011; AVB 2011); one trial compared the Ahmed implant with the single-plate Molteno implant (Nassiri 2010); and two trials compared the double-plate Molteno implant with the Schocket shunt (Smith 1992; Wilson 1992).

Aqueous shunts compared with and without modification (18 trials)

Of the trials that compared the same aqueous shunt with versus without modifications, 14 trials compared modifications among Ahmed implants. Two trials compared early aqueous suppression versus a standard medication regimen for postoperative increases in IOP (Law 2016; Pakravan 2014). Four trials evaluated an anti-vascular endothelial growth factor (VEGF) agent, with one trial using ranibizumab, Desai 2013, and three trials using bevacizumab (Arcieri 2015; Mahdy 2013; Rojo-Arnao 2011). Two trials evaluated a corticosteroid, with one trial comparing intravitreal triamcinolone versus none (Teixeira 2012), and another trial comparing topical dexamethasone versus topical ketorolac (Yuen 2011). Three trials investigated shunt augmentation, with one trial each comparing Ahmed implant with amniotic membrane, Yazdani 2016, biodegradable collagen matrix, Rho 2015, or pericardium, Hwang 2004, with Ahmed implant alone. Two trials compared surgical modifications, with one trial comparing partial tube ligation versus no ligation (Kee 2001), and the second comparing pars plana implantation versus conventional implantation (Parihar 2016). One trial compared two models (M4 versus S2) of the Ahmed implant (Gil-Carrasco 2016).

One trial compared two sizes of Baerveldt implants, 500 mm^2 versus 350 mm^2 (Britt 1999).

Three trials evaluated modifications among Molteno implants. One trial compared the use of oral corticosteroids versus no oral corticosteroids (Valimaki 1999); one trial compared double-plate versus single-plate implants (Heuer 1992); and one trial compared pressure-ridge implants versus standard implants with tube ligation (Gerber 1997).

Types of outcomes

1. Control of IOP

All but one trial measured mean IOP at baseline and at varying time points of follow-up (Heuer 1992). Nineteen trials had IOP threshold criteria, though none of these trials used the threshold definitions that were specified a priori in this review. As no study reported the mean change in IOP from baseline with standard deviations, we did not compare mean change in IOP from baseline as a continuous IOP outcome in this review. As all included studies were randomized, and participants in a randomized study are likely to have similar baseline characteristics between two groups, we used final mean IOP estimates to compare the treatment effect between groups.

2. Visual acuity

Ten trials measured mean logMAR visual acuity at varying time points of follow-up (ABC 2011; AVB 2011; Law 2016; Nassiri 2010; Pakravan 2007; TVT 2009; Wilson 2000; Wilson 2003; Yazdani 2016; Yuen 2011). We did not analyze dichotomous visual acuity data in this review due to variation in the outcome definitions used in each trial (e.g. proportion with 2 or more lines of vision loss, proportion with stable vision by a variety of definitions, Kaplan-Meier estimates of cumulative proportion without vision loss).

3. Postoperative hypertensive phase

Two trials compared the duration of a recognizable postoperative hypertensive phase (Law 2016; Pakravan 2014), three trials compared the time to onset of the hypertensive phase (Law 2016; Nassiri 2010; Yuen 2011), and one trial compared the frequency of occurrence of a hypertensive phase (Rho 2015).

4. Visual field

Three trials measured visual field data after baseline (Nassiri 2010; Wilson 2000; Wilson 2003); one of these trials reported dichotomized visual field outcomes (Nassiri 2010).

5. Antiglaucoma medications

The average number of postoperative glaucoma medications was reported in all except five trials (Desai 2013; Gerber 1997; Gil-Carrasco 2016; Kee 2001; Mahdy 2013).

6. Additional glaucoma surgery

Nine trials reported rates of reoperation to control glaucoma progression (ABC 2011; AVB 2011; Hwang 2004; Law 2016; Mahdy 2013; TVT 2009; Valimaki 1999; Wilson 2000; Wilson 2003).

7. Adverse events

All but one trial reported outcomes related to postoperative complications (Rojo-Arnao 2011).

8. Quality of life

One trial included quality of life as a prespecified outcome but did not report any results related to quality of life (TVT 2009).

Excluded studies

We excluded 19 studies after review of the full-text report; most were retrospective comparative case series. These studies are outlined in the Characteristics of excluded studies table.

Risk of bias in included studies

The risk of bias of trials included in this review varied across studies. The results of our 'Risk of bias' assessment are described in detail in the Characteristics of included studies table and summarized in Figure 2 and Figure 3. Below is a concise overall summary of our 'Risk of bias' assessment of trials included in this review.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

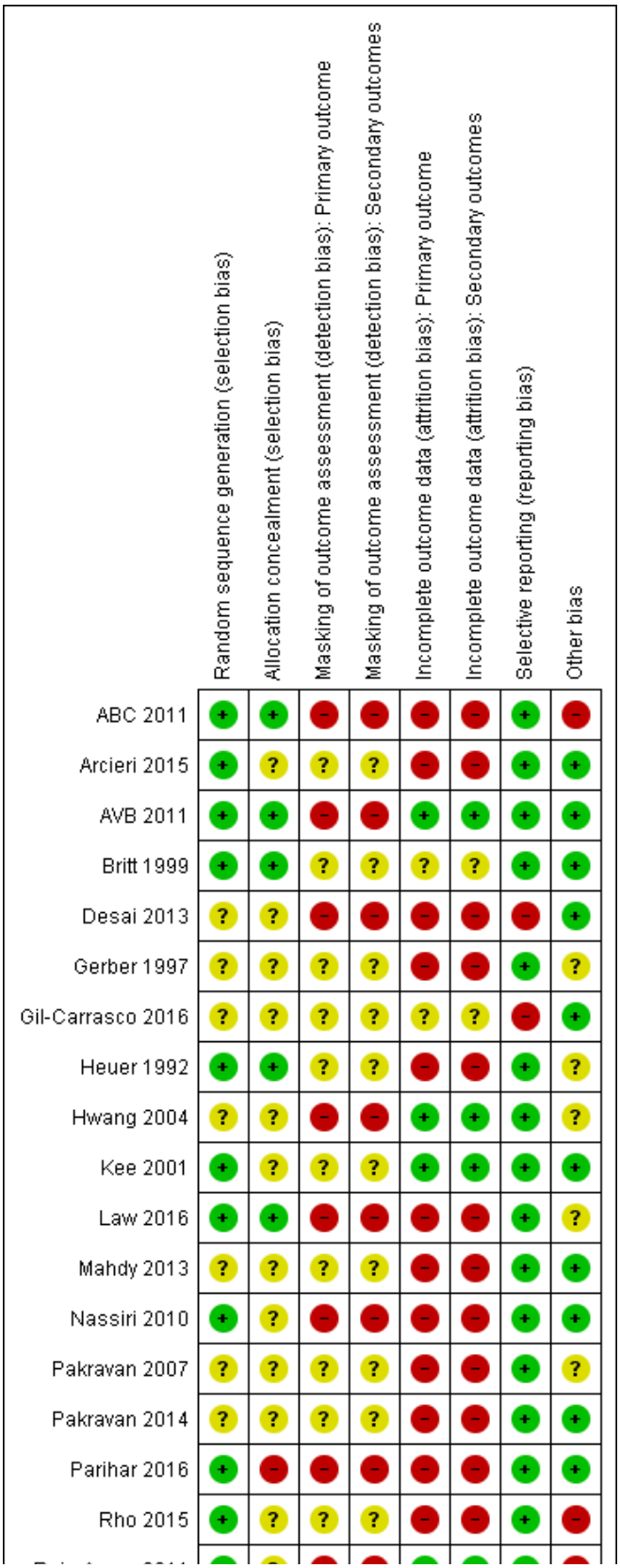


Figure 2. (Continued)

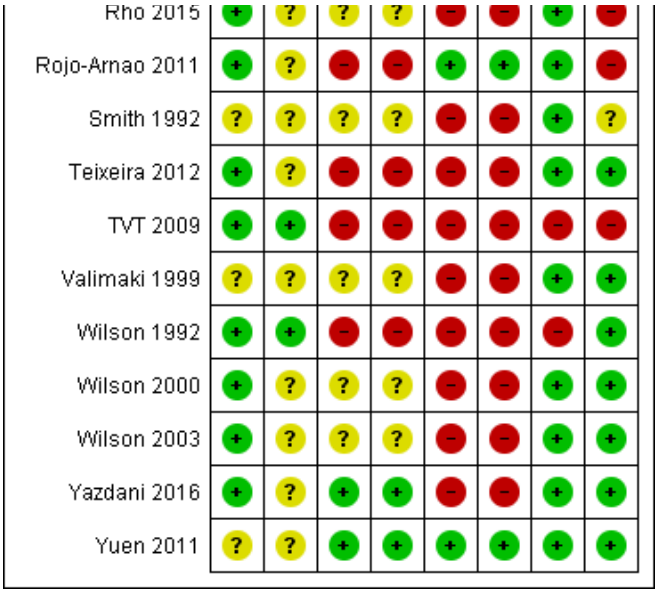
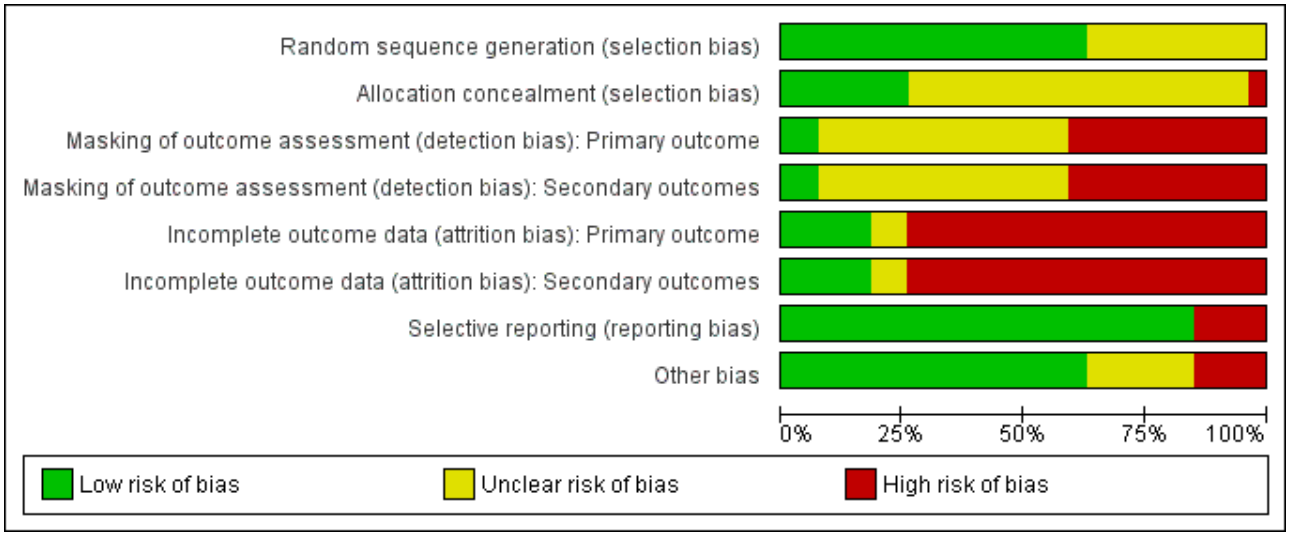


Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Allocation

The method of random sequence generation was stated explicitly and considered methodologically adequate in 17 of 27 trials (ABC 2011; Arcieri 2015; AVB 2011; Britt 1999; Heuer 1992; Kee 2001; Law 2016; Nassiri 2010; Parihar 2016; Rho 2015; Rojo-Arnao 2011; Teixeira 2012; TVT 2009; Wilson 1992; Wilson 2000; Wilson 2003; Yazdani 2016), and not explicitly stated in 10 trials (Desai 2013; Gerber 1997; Gil-Carrasco 2016; Hwang 2004; Mahdy 2013; Pakravan 2007; Pakravan 2014; Smith 1992; Valimaki 1999; Yuen 2011). The method of allocation concealment was at low risk of bias in seven trials (ABC 2011; AVB 2011; Britt 1999; Heuer 1992; Law 2016; TVT 2009; Wilson 1992), at high risk in one trial (Parihar 2016), and unclear risk for the remaining 19 included trials.

Masking (detection bias)

We judged two trials that reported masking of outcome assessors as at low risk of detection bias (Yazdani 2016; Yuen 2011). We judged 11 trials as at high risk of detection bias, as they explicitly stated that outcome assessors were not masked (ABC 2011; AVB 2011; Desai 2013; Hwang 2004; Law 2016; Nassiri 2010; Parihar 2016; Rojo-Arnao 2011; Teixeira 2012; TVT 2009; Wilson 1992). The remaining 14 included trials did not specify masking of outcome assessors, thus we assessed these studies as at unclear risk of bias.

Incomplete outcome data

We considered five trials to be at low risk for attrition bias because they either followed intention-to-treat analysis, AVB 2011, or had no losses to follow-up (Hwang 2004; Kee 2001; Rojo-Arnao 2011;

Yuen 2011), and thus included all participants in all analyses. Twenty trials did not analyze data from all participants and were thus judged as at high risk of attrition bias: 12 trials included all randomized participants at baseline, but excluded participants from analyses as they were lost to follow-up without use of imputation methods (ABC 2011; Arcieri 2015; Gerber 1997; Heuer 1992; Law 2016; Nassiri 2010; Smith 1992; Teixeira 2012; TVT 2009; Wilson 2000; Wilson 2003; Yazdani 2016); seven trials excluded randomized participants with missing data from all analyses (Desai 2013; Mahdy 2013; Pakravan 2007; Pakravan 2014; Parihar 2016; Valimaki 1999; Wilson 1992); and one trial did not report the number of participants at baseline (Rho 2015). We assessed the remaining two trials as at unclear risk of bias because they did not report the number of participants analyzed (Britt 1999; Gil-Carrasco 2016).

Selective reporting

We did not find evidence of selective outcome reporting for 23 trials; in these trials outcome measurements described in the Methods section and reported in the Results section of the study papers were consistent. Three trials published design and methods papers separate from outcome data; two of these trials reported results for all outcomes specified a priori (ABC 2011; AVB 2011), and one did not (TVT 2009). Two studies specified in the Methods section that outcome information was collected but did not report results for these outcomes (Desai 2013; Gil-Carrasco 2016). One study planned for 12 months only reported outcomes at 6 months (Wilson 1992). We thus assessed the latter four studies as at high risk of selective outcome reporting (Desai 2013; Gil-Carrasco 2016; TVT 2009; Wilson 1992).

Other potential sources of bias

We assessed 17 studies as at low risk of other potential sources of bias as we identified no other potential sources of bias in these trials (Figure 2). We judged four trials to be at high risk of bias for this domain, two trials because of direct financial conflicts of interest, as each study received funding from maker of the aqueous shunt examined in the study (ABC 2011; TVT 2009); one trial because participants experiencing postoperative complications were excluded from the study (Rho 2015); and one trial because they did not collect or report information on complications (Rojo-Arnao 2011). Risk of other potential sources of bias was unclear in six trials: the authors of one study disclosed financial interest in a competing device not under investigation in the study (Heuer 1992), and five trials used eyes as the unit of analysis without accounting for non-independence (Gerber 1997; Hwang 2004; Law 2016; Pakravan 2007; Smith 1992).

Effects of interventions

See: **Summary of findings for the main comparison** Aqueous shunts versus trabeculectomy; **Summary of findings 2** Ahmed implant versus Baerveldt implant; **Summary of findings 3** Ahmed implant versus Molteno implant; **Summary of findings 4** Molteno implant versus Schocket shunt

All interventions evaluated in this review are summarized in Table 1. See Summary of findings for the main comparison for aqueous shunts versus trabeculectomy, Summary of findings 2 for Ahmed implant versus Baerveldt implant, Summary of findings 3 for Ahmed implant versus Molteno implant, and Summary of findings 4 for Molteno implant versus Schocket shunt.

Aqueous shunts compared with trabeculectomy (4 trials)

Four trials compared an aqueous shunt with trabeculectomy: three trials used the Ahmed implant (Pakravan 2007; Wilson 2000; Wilson 2003), and one trial used the Baerveldt implant (TVT 2009). Wilson 2000 and Wilson 2003 included participants with primary open- or closed-angle glaucoma and participants in the trabeculectomy groups could have received adjunct mitomycin C (MMC) at the discretion of the surgeon. Wilson 2000 reported results up to 1 year (11 to 13 months) of follow-up, while Wilson 2003 reported results up to 4 years (50 to 52 months) of follow-up. TVT 2009 compared the 350 mm^2 Baerveldt implant versus trabeculectomy with MMC for participants with glaucoma and a history of previous trabeculectomy or cataract surgery. The study duration was five years with outcomes published at one, three, and five years. Pakravan 2007, which compared the Ahmed implant with MMC versus trabeculectomy with MMC among 30 children with pediatric aphakic glaucoma, did not report outcomes at specific follow-up time points, but rather aggregated results from the final follow-up visits for each participant. Mean follow-up was 13.1 ± 9.7 months in the Ahmed implant group and 14.8 ± 11 months in the trabeculectomy group. Because we did not have outcome data at a follow-up time point, we did not include this trial in formal analyses of study results.

All analyses for this comparison use the trabeculectomy group as the reference group. Of 452 participants randomized in the three trials (221 aqueous shunt, 231 trabeculectomy), analyzable data were reported for 380 (84%) participants at one-year follow-up. The overall risk of bias for these studies was unclear to high for most domains.

1. Control of IOP

Mean IOP

Three trials reported mean IOP at one-year follow-up (Analysis 1.1). We extracted the data on mean IOP from figures in the published reports for Wilson 2000 and Wilson 2003. At one-year follow-up, the mean IOP was 2.55 mmHg (95% confidence interval (CI) -0.78 to 5.87) higher in the aqueous shunt groups compared with the trabeculectomy groups. When analyzing only the Ahmed implant, the summary mean difference was 3.81 mmHg (95% CI 1.94 to 5.68; I^2 = 54%), favoring the trabeculectomy group.

Mean differences in IOP at time points of 6 months, 3 years, 4 years, and 5 years are also summarized in Analysis 1.1. The mean difference for IOP in TVT 2009 was 0.70 mmHg (95% CI -0.75 to 2.15) at 6 months' follow-up, -0.30 mmHg (95% CI -2.27 to 1.67) at 3 years' follow-up, and 1.80 mmHg (95% CI -0.46 to 4.06) at 5 years' follow-up; at 4 years' follow-up, Wilson 2003 reported similar mean IOPs in the Ahmed implant group and the trabeculectomy group, suggesting no difference in IOP outcomes between the two groups at the assessed follow-up time points.

We graded the certainty of evidence for mean IOP outcomes as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

IOP thresholds

TVT 2009 used two definitions for IOP success. Complete success was defined as IOP > 5 mmHg and ≤ 21 mmHg, reduced by at least 20% on two consecutive visits after three months, with no supplemental glaucoma medication, reoperation for glaucoma, or

loss of light perception vision. Qualified success was defined as the same but with supplemental glaucoma medication. At all three time points, results favored the trabeculectomy group for complete success and the Baerveldt implant group for at least qualified-success outcomes. IOP threshold outcomes at one, three, and five years are summarized in Analysis 1.2, Analysis 1.3, and Analysis 1.4, respectively.

TVT 2009 also performed subgroup analyses of IOP threshold outcomes in participants with previous cataract surgery and in participants with previous trabeculectomy. We did not include these results in formal analyses because the total number of participants with each type of surgery in each strata was not available. In participants with previous cataract surgery at five years' follow-up, the rates for complete success and qualified success were 26% and 48%, respectively, in the Baerveldt implant group and 15% and 26%, respectively, in the trabeculectomy group. In participants with previous trabeculectomy at five years' follow-up, the rates for complete success and qualified success were 0% and 46%, respectively, in the Baerveldt implant group and 29% and 29%, respectively, in the trabeculectomy group.

Wilson 2000 and Wilson 2003 reported cumulative probabilities of success as percentages without providing numerators and denominators, thus we were unable to perform meta-analysis for these results. Both studies defined surgical success as IOP > 5 mmHg and < 21 mmHg with at least 15% reduction from baseline with no need for further glaucoma surgery and no loss of light perception. The two studies demonstrated similar proportions of participants with success at one-year follow-up (88.07% Ahmed, 83.63% trabeculectomy in Wilson 2000; 87.90% Ahmed, 93.40% trabeculectomy in Wilson 2003). Wilson 2003 reported similar success percentages between the two groups at four years' follow-up (69.80% Ahmed, 68.10% trabeculectomy).

We graded the certainty of evidence for dichotomous IOP outcomes as very low, downgrading for risk of bias (-1), heterogeneity (-1), and reporting bias (-1).

2. Visual acuity

The summary mean differences of visual acuity scores at different time points are shown in Analysis 1.5. At one-year follow-up, the summary mean difference was 0.12 logMAR units (95% CI -0.07 to 0.31). When analyzing only the two Ahmed studies, the summary mean difference was 0.92 units (95% CI -4.68 to 6.52); the wide confidence interval suggests statistical imprecision, therefore results should be interpreted with caution.

In the TVT 2009 study, at three years' and five years' follow-up, mean differences were 0.04 logMAR units (95% CI -0.17 to 0.25) and 0.20 logMAR units (95% CI -0.08 to 0.48), respectively. At four years' follow-up, the calculated mean difference from data in Wilson 2003 was -0.88 logMAR units (95% CI -2.17 to 0.41); the wide confidence interval suggests statistical imprecision, therefore results should be interpreted with caution.

We graded the certainty of evidence for mean visual acuity outcomes as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

3. Postoperative hypertensive phase

TVT 2009, Wilson 2000, and Wilson 2003 did not report outcomes related to the postoperative hypertensive phase.

4. Visual field

Two studies reported the mean change in visual field score from baseline using the Advanced Glaucoma Intervention Study (AGIS) algorithm (Wilson 2000; Wilson 2003). Using this algorithm, a negative change suggests that the visual field is worse, while a positive change suggests improvement of visual field. The summary mean difference for change in visual field score at one year was -0.25 (95% CI -1.91 to 1.40), which suggested uncertainty in any difference between groups (Analysis 1.6). The mean difference at four years based on data reported by Wilson 2003 was -5.02 (95% CI -5.65 to -4.39), which strongly favored the trabeculectomy group.

TVT 2009 did not report visual field data.

We graded the certainty of evidence for mean visual field outcomes as very low, downgrading for risk of bias (-1), imprecision (-1), and publication bias (-1).

5. Antiglaucoma medications

Three trials reported the mean number of antiglaucoma medications taken after surgery; however, only TVT 2009 reported sufficient data for analysis. The mean differences for the number of glaucoma medications at various time points are summarized in Analysis 1.7. The mean difference for number of glaucoma medications was 0.60 medications (95% CI 0.28 to 0.92) at six months' follow-up; 0.80 medications (95% CI 0.48 to 1.12) at one-year follow-up; 0.30 medications (95% CI -0.17 to 0.77) at three years' follow-up; and 0.20 medications (95% CI -0.29 to 0.69) at five years' follow-up. The results favored the trabeculectomy group at all time points.

Wilson 2000 reported that the mean number of glaucoma medications at one-year follow-up was 0.8 in the Ahmed group and 0.3 in the trabeculectomy group. Wilson 2003 reported results from the date of last examination, which occurred at different time points of follow-up; the mean number of glaucoma medications at last follow-up was 1.13 ± 0.14 in the Ahmed group and 0.93 ± 0.11 in the trabeculectomy group.

We graded the certainty of evidence for mean number of antiglaucoma medications outcomes as low, downgrading for risk of bias (-1) and publication bias (-1).

6. Additional glaucoma surgery

Three trials reported the proportion of participants undergoing reoperation for glaucoma progression: TVT 2009 at 1, 3, and 5 years' follow-up; Wilson 2000 at 1 year; and Wilson 2003 at 4 years. Data are summarized in Analysis 1.8. At one year, the risk of reoperation was 0.24 (95% CI 0.04 to 1.36) when comparing the aqueous shunt group with the trabeculectomy group.

In TVT 2009, the aqueous shunt group had a lower risk of reoperation at three and five years' follow-up, risk ratio (RR) 0.49 (95% CI 0.19 to 1.26) and RR 0.44 (95% CI 0.20 to 0.96), respectively. In Wilson 2003, the RR for reoperation was 2.17 (95% CI 0.41 to 11.41) at four years' follow-up. Types of reoperations included tube shunts with or without bleb revisions, transscleral

cyclophotocoagulation, and endoscopic cytophotocoagulation combined with cataract extraction.

We graded the certainty of evidence for additional glaucoma surgery outcomes as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

7. Adverse events

Three trials reported the proportion of participants experiencing specific complications after surgery: TVT 2009 at 1, 3, and 5 years' follow-up; Wilson 2000 at 1 year; and Wilson 2003 at 4 years. TVT 2009 was the only study to report the total number of participants who had at least one adverse event: fewer participants in the aqueous shunt group than in the trabeculectomy group experienced an adverse event at one and three years' follow-up (RR 0.59, 95% CI 0.43 to 0.81 and RR 0.65, 95% CI 0.49 to 0.87, respectively).

The complete analyses of complications assessed by the three trials are reported in Analysis 1.9; Analysis 1.10; Analysis 1.11; Analysis 1.12. Because of the small number of events for each specific adverse event relative to the sample size, most estimates are very imprecise. The most commonly reported adverse events (10 or more cases) were flat anterior chamber, choroidal effusion, hyphema, and persistent corneal edema in the aqueous shunt group, and flat anterior chamber and choroidal effusion in the trabeculectomy group.

We graded the certainty of evidence for adverse events as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

8. Quality of life

TVT 2009 prespecified quality of life as an outcome but did not report any results related to quality of life. Neither Wilson 2000 nor Wilson 2003 reported quality of life as an outcome.

Aqueous shunts compared with other aqueous shunts (5 trials)

Ahmed implant versus Baerveldt implant

Two trials evaluated the Ahmed implant versus 350 mm^2 Baerveldt implant (ABC 2011; AVB 2011). Both were five-year studies with three-year outcomes and complications published; ABC 2011 also published five-year treatment outcomes and complications. The two studies enrolled a total of 514 participants (267 Ahmed, 247 Baerveldt) with 397 (207 Ahmed, 190 Baerveldt) remaining at three years. All analyses for this comparison use the Baerveldt implant group as the reference group.

1. Control of IOP

Mean IOP

The summary mean differences of IOP between the Ahmed and Baerveldt implant groups are shown in Analysis 2.1. The summary mean difference for IOP was 2.60 mmHg (95% CI 1.58 to 3.62) at one-year follow-up, 1.24 mmHg (95% CI 0.31 to 2.18) at three years' follow-up, and 2.00 mmHg (95% CI 0.68 to 3.32) at five years' follow-up. The summary mean difference at all these time points favored the Baerveldt implant, though a 1 to 2 mmHg difference in IOP reduction between the two groups is not necessarily clinically significant, and may also represent physiologic IOP fluctuation.

We graded the certainty of evidence for mean IOP outcomes as moderate, downgrading for risk of bias (-1).

IOP thresholds

The two studies had different definitions of surgical success and thus IOP threshold outcomes were not combined for analysis. ABC 2011 defined complete success as IOP > 5 mmHg and ≤ 21 mmHg with at least 20% reduction from baseline and no adjunctive medications, and qualified success as the same but with adjunctive medications. AVB 2011 defined complete success as IOP 5 to 18 mmHg with at least 20% reduction from baseline, no adjunctive medications, no vision-threatening complications, no additional glaucoma surgery or laser, and no greater than doubling of the logMAR vision; qualified success was the same but with adjunctive medications.

Both studies showed higher rates of complete success in the Baerveldt group but similar rates of qualified success between the two groups at one-year follow-up. Neither study reported qualified success rates at three years' follow-up. ABC 2011 reported complete success at one-year follow-up for 27 participants (23%) in the Ahmed implant group and 41 participants (36%) in the Baerveldt implant group (RR 0.63, 95% CI 0.42 to 0.95). Qualified success was reported for 92 participants (77%) in the Ahmed implant group and 73 participants (64%) in the Baerveldt implant group, thus 100% of participants in both groups had complete or qualified success at one-year follow-up (RR 1.00, 95% CI 0.98 to 1.02). At three years' follow-up, complete success rates were 15 participants (20%) in the Ahmed group and 23 participants (33%) in the Baerveldt group (RR 0.61, 95% 0.35 to 1.07).

AVB 2011 reported complete success at one-year follow-up for 9 participants (8%) in the Ahmed implant group and 18 participants (17%) in the Baerveldt implant group (RR 0.45, 95% CI 0.21 to 0.96). Qualified success was reported for 60 participants (50%) in the Ahmed implant group and 60 participants (56%) in the Baerveldt implant group, thus 69 participants in the Ahmed implant group and 78 participants in the Baerveldt implant group had complete or qualified success at one-year follow-up (RR 0.80, 95% CI 0.66 to 0.97). At three years' follow-up, complete success rates were 5 participants (4%) in the Ahmed group and 13 participants (11%) in the Baerveldt group (RR 0.36, 95% 0.13 to 0.99).

We graded the certainty of evidence for mean IOP outcomes as low, downgrading for risk of bias (-1) and heterogeneity (-1).

2. Visual acuity

The summary mean differences of logMAR visual acuity between the Ahmed and Baerveldt implant groups are shown in Analysis 2.2. The summary mean difference for logMAR visual acuity was -0.07 logMAR units (95% CI -0.27 to 0.13) at one-year follow-up, -0.02 logMAR units (95% CI -0.25 to 0.22) at three years' follow-up, and -0.01 logMAR units (95% CI -0.39 to 0.37) at five years' follow-up. We graded the certainty of evidence for mean visual acuity outcomes as low, downgrading for risk of bias (-1) and imprecision (-1).

3. Postoperative hypertensive phase

ABC 2011 and AVB 2011 did not report outcomes related to the postoperative hypertensive phase.

4. Visual field

ABC 2011 and AVB 2011 did not report visual field outcomes.

5. Antiglaucoma medications

The summary mean differences of number of glaucoma medications between the Ahmed and Baerveldt implant groups are shown in Analysis 2.3. The summary mean difference for number of glaucoma medications was 0.50 medications (95% CI 0.27 to 0.73) at six months' follow-up, 0.35 medications (95% CI 0.11 to 0.59) at one-year follow-up, 0.60 medications (95% CI 0.33 to 0.87) at three years' follow-up, and 0.40 medications (95% CI -0.03 to 0.83) at five years' follow-up. The effect estimates favored the Baerveldt implant group at these time points. We graded the certainty of evidence as moderate, downgrading for risk of bias (-1).

6. Additional glaucoma surgery

The summary risk ratios for reoperation at various time points are shown in Analysis 2.4. At both one and three years, the Ahmed group demonstrated a higher risk of reoperation for the control of glaucoma progression (RR 2.77, 95% CI 1.02 to 7.54 and RR 1.98, 95% CI 1.08 to 3.65, respectively). We graded the certainty of evidence for reoperation as moderate, downgrading for risk of bias (-1).

7. Adverse events

Analyses of complications at one, three, and five years are shown in Analysis 2.5, Analysis 2.6, and Analysis 2.7, respectively. The summary risk ratios for many specific adverse events demonstrated uncertainty of the comparative risk of complications due to small numbers of events (e.g. choroidal effusion: RR 1.13, 95% CI 0.73 to 1.76). The Ahmed implant group had a higher risk of bleb encapsulation at both one and three years (RR 4.29, 95% CI 1.27 to 14.54 and RR 4.08, 95% 1.31 to 12.72, respectively). The Ahmed implant group had a lower risk of corneal edema at both one and three years (RR 0.46, 95% CI 0.31 to 0.69 and RR 0.62, 95% 0.43 to 0.88, respectively) and tube obstruction at both one and three years (RR 0.36, 95% 0.17 to 0.77 and RR 0.21, 95% 0.07 to 0.59, respectively). We graded the certainty of evidence for adverse events as low, downgrading for risk of bias (-1) and imprecision (-1).

8. Quality of life

ABC 2011 and AVB 2011 did not report quality of life outcomes.

Ahmed implant versus Molteno implant

One trial evaluated the Ahmed implant versus the single-plate Molteno implant for glaucoma (Nassiri 2010). The study enrolled 92 participants with 46 per group. As the study reported data sufficient for analysis at 24 months' follow-up only, we have focused on the 24-month outcomes. At the end of follow-up, 29 participants remained in the Ahmed group and 28 participants in the Molteno group. The Molteno group was used as the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

Mean IOP outcomes are summarized in Analysis 3.1. While mean IOP was reported at various time points throughout the study, only 24-month data from the study included information on the number of participants included in the analysis. Among the 57 participants who completed the trial, mean IOP was higher in the Ahmed group than in the Molteno group (mean difference (MD) 1.64 mmHg, 95% CI 0.85 to 2.43). We graded the certainty of evidence for mean IOP as low, downgrading for risk of bias (-1) and indirectness (-1).

IOP thresholds

IOP threshold outcomes at 24 months are summarized in Analysis 3.2. Nassiri 2010 defined complete success as IOP from 6 to 21 mmHg without any glaucoma medication and qualified success as the same but with glaucoma medications. Although the two groups had similar proportions of complete success, the difference between the two groups for complete success at 24 months' follow-up was uncertain (RR 0.97, 95% CI 0.67 to 1.39). All participants in both groups achieved qualified or complete success (RR 1.00, 95% CI 0.94 to 1.07) at 24 months' follow-up. We graded the certainty of evidence for IOP thresholds as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

2. Visual acuity

Visual acuity outcomes are summarized in Analysis 3.3. While mean logMAR visual acuity was reported at various time points throughout the study, only 24-month data from the study included information on the number of participants included in the analysis. Among the 57 participants who completed the trial, differences in visual acuity outcomes between the two groups were uncertain (MD 0.08 logMAR units, 95% CI -0.24 to 0.40). We graded the certainty of evidence for visual acuity as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

3. Postoperative hypertensive phase

We did not include hypertensive phase data in formal analyses because the total number analyzed in each group was unclear. Nassiri 2010 defined the hypertensive phase as IOP > 21 mmHg during the first three postoperative months after a reduction of IOP to < 22 mmHg during the first postoperative week, and not caused by tube obstruction, retraction, or valve malfunction. In the Ahmed implant group, 13 eyes developed the hypertensive phase with a mean time to onset of 5.5 (standard deviation (SD) 1.7) weeks. In the Molteno group, 8 eyes developed the hypertensive phase with a mean time to onset of 6.0 (SD 1.3) weeks.

4. Visual field

Visual field outcomes are summarized in Analysis 3.4. The two groups demonstrated similar mean deviation in Humphrey visual fields at 24 months' follow-up (MD -0.18 dB, 95% CI -3.13 to 2.77). We graded the certainty of evidence for visual field as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

5. Antiglaucoma medications

The mean difference in number of glaucoma medications between the two groups is summarized in Analysis 3.5. While mean number of glaucoma medications was reported at various time points throughout the study, only 24-month data from the study included information on the number of participants included in the analysis. The mean number of glaucoma medications was within one between the two groups (MD -0.38 medications, 95% CI -1.03 to 0.27). We graded the certainty of evidence as low, downgrading for risk of bias (-1) and indirectness (-1).

6. Additional glaucoma surgery

Nassiri 2010 did not report outcomes related to additional glaucoma surgery.

7. Adverse events

Complications at 24 months are summarized in Analysis 3.6. Due to the small sample size and low number of events for many complications reported, the effects between groups for adverse events were uncertain. We graded the certainty of evidence for adverse events as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

8. Quality of life

Nassiri 2010 did not report quality of life outcomes.

Molteno implant versus Schocket shunt

Two trials compared the double-plate Molteno implant with the Schocket shunt for glaucoma (Smith 1992; Wilson 1992). As Smith 1992 did not report data at specific follow-up times, we only included data from Wilson 1992 in formal analyses. Smith 1992 enrolled a total of 40 participants, with 19 in the Molteno group and 21 in the Schocket shunt group. Wilson 1992 enrolled a total of 118 participants, with 65 in the Molteno group and 53 in the Schocket shunt group, and reported outcomes at six months' follow-up. The Schocket shunt group was used as the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

At final follow-up in Smith 1992, mean IOP was 14.39 (SD 4.24) mmHg in the Molteno group and 15.05 (SD 7.65) mmHg in the Schocket shunt group. Mean IOP data for Wilson 1992 are summarized in Analysis 4.1. At six months' follow-up, mean IOP was lower in the Molteno group (MD -2.50 mmHg, 95% CI -4.60 to -0.40). We graded the certainty of evidence as low, downgrading for risk of bias (-1) and indirectness (-1).

IOP thresholds

Smith 1992 and Wilson 1992 did not report outcomes related to IOP thresholds.

2. Visual acuity

Smith 1992 and Wilson 1992 did not report visual acuity outcomes.

3. Postoperative hypertensive phase

Smith 1992 and Wilson 1992 did not report outcomes related to the postoperative hypertensive phase.

4. Visual field

Smith 1992 and Wilson 1992 did not report outcomes related to visual field.

5. Antiglaucoma medications

At final follow-up, Smith 1992 reported a mean of 0.95 (SD 0.75) medications in the Molteno group and 0.43 (SD 0.68) medications in the Schocket shunt group. Wilson 1992 did not report the mean number of medications in each group at any follow-up point.

6. Additional glaucoma surgery

Smith 1992 and Wilson 1992 did not report outcomes related to additional glaucoma surgery.

7. Adverse events

Smith 1992 did not report adverse events. Complications in Wilson 1992 are summarized in Analysis 4.2. Due to the small sample size and low number of events for many complications reported, the effects between groups for adverse events were uncertain. We graded the certainty of evidence for adverse events as low, downgrading for risk of bias (-1) and imprecision (-1).

8. Quality of life

Smith 1992 and Wilson 1992 did not report quality of life outcomes.

Aqueous shunts compared with and without modification (18 trials)

Ahmed implant modifications: Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen

Two studies compared the Ahmed implant with early aqueous suppression versus the Ahmed implant with a standard medication regimen (Law 2016; Pakravan 2014). Both studies defined early aqueous suppression as the initiation of glaucoma medications postoperatively when IOP increased above 10 mmHg. The two studies enrolled a total of 146 participants with 73 per group. Law 2016 reported two years of follow-up data, while Pakravan 2014 reported one year of follow-up data. The Ahmed implant with standard medication regimen group was used as the reference group for all analyses in this comparison.

1. Control of IOP

Mean IOP

The summary mean differences in IOP at various time points are summarized in Analysis 5.1. At six months' follow-up, the early aqueous suppression group demonstrated a lower mean IOP than the standard medication regimen group (MD -4.02 mmHg, 95% CI -5.51 to -2.53). At one-year follow-up, mean IOPs were similar in the two groups (MD -0.20, 95% CI -3.45 to 3.05). We graded the certainty of evidence for mean IOP as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

IOP thresholds

Only Pakravan 2014 reported IOP threshold outcomes, but this study did not provide denominators for all time points, so we did not include dichotomized IOP outcomes in our formal analyses. Pakravan 2014 defined complete success as IOP > 6 mmHg and < 15 mmHg without glaucoma medications and qualified success as the same but with medications. At all follow-up time points, the Ahmed with early aqueous suppression group demonstrated higher rates of both complete and qualified success, with 15.8% versus 4.8% for complete success and 47.4% versus 28.6% for qualified success in the early suppression versus standard regimen groups at final one-year follow-up.

2. Visual acuity

Visual acuity outcomes were reported by Law 2016 only and are summarized in Analysis 5.2. At one-year follow-up, the mean logMAR visual acuity was similar in both groups (MD 0.00, 95% CI -0.42 to 0.42). We graded the certainty of evidence as low, downgrading for risk of bias (-1) and imprecision (-1).

3. Postoperative hypertensive phase

Duration of postoperative hypertensive phase

The two studies defined the postoperative hypertensive phase differently, and duration was reported in days in Law 2016 and in weeks in Pakravan 2014. Because of these differences, we did not attempt to combine results from the two studies or include them in our formal analyses.

Law 2016 defined the hypertensive phase as IOP > 21 mmHg during the first six postoperative months after an initial reduction of IOP to < 22 mmHg during the first postoperative week, not caused by tube obstruction, retraction, or valve malfunction. In the early aqueous suppression group, 9/26 (34.6%) of participants developed the hypertensive phase for a mean of 15.7 ± 36.8 days. In the standard medication regimen group, 12/26 (46.2%) of participants developed the hypertensive phase for a mean of 15.2 ± 26.8 days. The difference in mean duration of the hypertensive phase between the two groups was reported as not statistically significant.

Pakravan 2014 defined the hypertensive phase as IOP > 21 mmHg in the first three months after surgery. In the early aqueous suppression group, 11/47 (23.4%) of participants developed the hypertensive phase for a mean of 11.2 ± 13.3 weeks. In the standard medication regimen group, 31/47 (66.0%) of participants developed the hypertensive phase for a mean of 11.7 ± 12.4 weeks. The difference in mean duration of the hypertensive phase between the two groups was reported as not statistically significant.

Time to onset of hypertensive phase

Only Law 2016 reported the time to onset of the hypertensive phase, and we did not include the results in our formal analyses. In participants in the early aqueous suppression group who developed the hypertensive phase, the mean time to onset of the hypertensive phase was 26.8 ± 29.1 days. In participants in the standard medication regimen group who developed the hypertensive phase, the mean time to onset of the hypertensive phase was 35.8 ± 30.6 days. The difference in the mean time to onset of the hypertensive phase between the two groups was reported as not statistically significant.

4. Visual field

Law 2016 and Pakravan 2014 did not report outcomes related to visual field.

5. Antiglaucoma medications

The summary mean differences in number of glaucoma medications at various time points are summarized in Analysis 5.3. Meta-analysis at six months' postoperatively demonstrated a similar number of medications in the two groups (MD 0.30 medications, 95% CI -0.02 to 0.63). Only Law 2016 reported data at one-year follow-up, and results suggested no difference in the number of glaucoma medications between the two groups (MD 0.00 medications, 95% CI -0.56 to 0.56). We graded the certainty of evidence for number of antiglaucoma medications as moderate, downgrading for risk of bias (-1).

6. Additional glaucoma surgery

Only Law 2016 reported reoperation for glaucoma progression. In the early aqueous suppression group, there were three cases of reoperation, of which two were another Ahmed implant and one was a Baerveldt implant. In the standard medication regimen group, there were four cases of reoperation, of which two were trabeculectomy, one was another Ahmed implant, and one was a Baerveldt implant. The RR was 0.64 (95% CI 0.17 to 2.50). We graded the certainty of evidence as very low, downgrading for risk of bias (-1) and imprecision (-2).

7. Adverse events

We did not combine data on complications for formal analyses because the two studies compared different types of complications. Law 2016 reported one case of strabismus in the early aqueous suppression group, and one case of uveitis and two cases of corneal edema in the standard medication regimen group. Pakravan 2014 reported no statistically significant difference in the overall complication rate between the two groups.

8. Quality of life

Law 2016 and Pakravan 2014 did not report quality of life outcomes.

Ahmed implant modifications: Ahmed implant with anti-vascular endothelial growth factor agent versus Ahmed implant without anti-vascular endothelial growth factor agent

Four studies compared any anti-vascular endothelial growth factor (anti-VEGF) agent with no anti-VEGF agent in combination with Ahmed implant. One study compared intravitreal ranibizumab (n = 6) with no intravitreal ranibizumab (n = 5) for open-angle glaucoma (Desai 2013). Two studies compared intravitreal bevacizumab (n = 40) with no intravitreal bevacizumab (n = 40) for neovascular glaucoma (Arcieri 2015; Mahdy 2013); Mahdy 2013 also included panretinal photocoagulation in both study groups. One study compared subconjunctival bevacizumab (n = 7) with no subconjunctival bevacizumab (n = 6) for glaucoma (Rojo-Arnao 2011). Rojo-Arnao 2011 followed participants up to three months, Desai 2013 up to six months, Mahdy 2013 up to 18 months, and Arcieri 2015 up to 24 months. The Ahmed without anti-VEGF agent group was used as the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

All four studies reported mean IOP; however, Rojo-Arnao 2011 did not report standard deviations, so we were unable to include this study in formal analysis. After 45 days of follow-up, Rojo-Arnao 2011 reported that mean IOP was significantly lower for the group receiving subconjunctival bevacizumab compared with the group that did not (16.1 mmHg versus 26.0 mmHg). Due to differences in interventions and substantial statistical heterogeneity (> 90%), we did not combine individual study results in meta-analysis.

The mean differences in IOP for individual studies at various time points are shown in Analysis 6.1. At six months' follow-up, there was no evidence of a difference in mean IOP when comparing intravitreal ranibizumab with no ranibizumab (MD -1.50 mmHg, 95% CI -5.00 to 2.00) (Desai 2013), or when comparing intravitreal bevacizumab with no bevacizumab (MD 0.45 mmHg, 95% CI -3.75 to 4.65) (Arcieri 2015). In Mahdy 2013, mean IOP was 12.00 mmHg lower (95% CI -13.62 to -10.38) among participants in the intravitreal bevacizumab plus panretinal photocoagulation group than in the panretinal photocoagulation group.

Results for the Arcieri 2015 and Mahdy 2013 studies were similar at 12 months' follow-up. There was no evidence of a difference in mean IOP when comparing intravitreal bevacizumab with no bevacizumab (MD 1.40 mmHg, 95% CI -4.04 to 6.84) (Arcieri 2015). In Mahdy 2013, mean IOP was 12.00 mmHg lower (95% CI -16.79 to -7.21) among participants in the intravitreal bevacizumab plus panretinal photocoagulation group than in the panretinal photocoagulation group.

We graded the certainty of evidence for mean IOP as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

IOP thresholds

Three studies reported IOP threshold outcomes (Arcieri 2015; Desai 2013; Mahdy 2013); Rojo-Arnao 2011 did not report this outcome. We did not combine IOP threshold outcomes for formal analyses as the studies had different definitions of surgical success and different time points at which outcomes were reported.

Desai 2013 defined complete success as IOP < 18 mmHg without adjunctive medications or IOP < 15 mmHg with ≤ 1 adjunctive medication. At six months, 5/6 (83%) of participants with intravitreal ranibizumab and 2/5 (40%) of participants without intravitreal ranibizumab had achieved complete success according to the study guidelines (RR 2.08, 95% CI 0.67 to 6.46).

Arcieri 2015 reported dichotomous IOP outcomes at 24 months and defined success as (1) IOP between 6 and 21 mmHg with or without medications, and (2) IOP reduction at least 30% relative to preoperative values. Based on the first definition, they reported 13/20 cases of success (65.0%) in the intravitreal bevacizumab group and 12/20 cases of success (60.0%) in the no intravitreal bevacizumab group (RR 1.08, 95% CI 0.67 to 1.75). Based on the second definition, they reported 16/20 cases of success (80%) in the intravitreal bevacizumab group and 15/20 cases of success (75%) in the no intravitreal bevacizumab group (RR 1.07, 95% CI 0.76 to 1.49).

Mahdy 2013 defined complete success as IOP ≤ 21 mmHg and ≥ 10 mmHg without glaucoma medications, additional glaucoma surgery, visually devastating complications, or loss of light perception, and qualified success as the same but with glaucoma medications. In the intravitreal bevacizumab plus panretinal photocoagulation group, 15/20 participants (75%) had complete success; the number with complete success was not reported for the panretinal photocoagulation group. More participants in the intravitreal bevacizumab plus panretinal photocoagulation group (19/20) than in the panretinal photocoagulation group (5/20) had either complete or qualified success (RR 3.80, 95% CI 1.77 to 8.17).

We graded the certainty of evidence for IOP thresholds as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

2. Visual acuity

Desai 2013 and Rojo-Arnao 2011 did not report visual acuity outcomes.

Although Arcieri 2015 and Mahdy 2013 reported visual acuity outcomes, we could not combine the study results because Arcieri 2015 reported only P values. Arcieri 2015 reported that no significant between-group difference in logMAR visual acuity was observed postoperatively. Mahdy 2013 categorized visual acuity at the end of follow-up into "unchanged," "decreased," or "improved." A higher number of participants had improved visual acuity in the intravitreal bevacizumab plus panretinal photocoagulation group (12/20) compared with the group that did not receive intravitreal bevacizumab (3/20) (RR 4.00, 95% CI 1.33 to 12.05).

We graded the certainty of evidence for visual acuity as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

3. Postoperative hypertensive phase

None of these studies reported on the postoperative hypertensive phase.

4. Visual field

None of these studies reported on outcomes related to visual field.

5. Antiglaucoma medications

Mahdy 2013 did not report the number of antiglaucoma medications. Rojo-Arnao 2011 reported that the mean number of antiglaucoma medications needed was 1.57 for the group receiving subconjunctival bevacizumab and 2.66 for the group that did not receive subconjunctival bevacizumab. Standard deviations were not reported, but the number of medications needed was reported as not significantly different between groups (P = 0.12).

At six months' follow-up, two studies reported the mean number of antiglaucoma medications needed (Arcieri 2015; Desai 2013); the difference between groups was not clinically meaningful (MD 0.00, 95% CI -0.63 to 0.64; Analysis 6.2). At one-year follow-up, the mean difference was similar for the Arcieri 2015 study (MD 0.03, 95% CI -0.65 to 0.71). We graded the certainty of evidence for antiglaucoma medications as low, downgrading for risk of bias (-1) and heterogeneity (-1).

6. Additional glaucoma surgery

As only one study reported outcomes on reoperation to control glaucoma progression (Mahdy 2013), we did not perform meta-analysis. In the intravitreal bevacizumab plus panretinal photocoagulation group, 1/20 participants (5%) required reoperation, while in the panretinal photocoagulation group, 10/20 participants (50%) required reoperation (RR 0.10, 95% CI 0.01 to 0.71). All participants who required reoperation received a second aqueous shunt. We graded the certainty of evidence for additional glaucoma surgery as very low, downgrading for risk of bias (-1) and imprecision (-2).

7. Adverse events

Neither Desai 2013 nor Rojo-Arnao 2011 reported adverse events.

Arcieri 2015 reported higher risk of flat anterior chamber and tube exposure in the intravitreal bevacizumab group, and higher risk of hyphema, choroidal effusion, corneal edema, severe inflammation, and retinal detachment in the no intravitreal bevacizumab group. Mahdy 2013 reported higher risk of all complications in the panretinal photocoagulation group; these included hyphema, tube occlusion, choroidal effusion, shallow anterior chamber, hypotony, tube-cornea touch, suprachoroidal hemorrhage, phthisis bulbi, encapsulated plate, tube/plate exposure, and corneal decompensation.

8. Quality of life

None of these studies reported quality of life outcomes.

Ahmed implant modifications: Ahmed implant with corticosteroids versus Ahmed implant without corticosteroids

Two studies evaluated the Ahmed implant with versus without corticosteroids (Teixeira 2012; Yuen 2011). Teixeira 2012 compared the Ahmed implant with intravitreal triamcinolone versus no intravitreal triamcinolone for neovascular glaucoma. The study enrolled a total of 49 participants (27 in the triamcinolone group and 22 in the no triamcinolone group) and reported 12 months of follow-up data. Yuen 2011 compared the Ahmed implant with postoperative topical dexamethasone versus ketorolac for glaucoma. The study enrolled a total of 28 participants (15 in the dexamethasone group and 13 in the ketorolac group) and reported results from 12 weeks of follow-up. Outcomes assessed included mean IOP, IOP threshold achievement, visual acuity, time to onset of hypertensive phase, mean number of antiglaucoma medications, and complications. As there were only 12 weeks of follow-up, we did not include data from Yuen 2011 in formal analyses.

1. Control of IOP

Mean IOP

Teixeira 2012 reported mean IOP at one-year follow-up. The mean IOP was 13.9 ± 3.7 mmHg and 15.5 ± 4.4 mmHg for Ahmed implant with and without intravitreal triamcinolone, respectively (MD -1.60 mmHg, 95% CI -4.03 to 0.83; Analysis 7.1). We graded the certainty of evidence for mean IOP as low, downgrading for risk of bias (-1) and imprecision (-1).

IOP thresholds

The IOP thresholds used in Teixeira 2012 were the absence of IOP > 21 mmHg or < 6 mmHg on two consecutive measurements, no light perception, glaucoma surgery, serious complications, or use of more than two medications to achieve target IOP. In the group that received intravitreal triamcinolone, 14/18 (78%) participants met this threshold, and in the group that did not receive intravitreal triamcinolone, 16/25 (64%) participants met this threshold. It was uncertain whether treatment with or without intravitreal triamcinolone resulted in the greater percentage of participants achieving the study-specific IOP thresholds (RR 1.22, 95% CI 0.83 to 1.78; Analysis 7.2). We graded the certainty of evidence for IOP thresholds as low, downgrading for risk of bias (-1) and imprecision (-1).

2. Visual acuity

Teixeira 2012 did not report visual acuity outcomes.

3. Postoperative hypertensive phase

Teixeira 2012 did not report on the postoperative hypertensive phase.

4. Visual field

Teixeira 2012 did not report visual field outcomes.

5. Antiglaucoma medications

At one-year follow-up, the mean number of medications in the group treated with intravitreal triamcinolone was 0.8 ± 0.8, and the mean number of medications in the group that did not receive intravitreal triamcinolone was 1.3 ± 1.2 (MD -0.50, 95% CI -1.10 to 0.10; Analysis 7.3). We graded the certainty of evidence as low, downgrading for risk of bias (-1) and imprecision (-1).

6. Additional glaucoma surgery

Teixeira 2012 did not report participants' need for additional glaucoma surgery.

7. Adverse events

Teixeira 2012 reported on a number of complications associated with the Ahmed implant with or with intravitreal triamcinolone. The following complications were reported by at least one participant in each treatment group: loss of light perception, phthisis bulbi, corneal decompensation, hemorrhagic choroidal detachment, hyphema, serious choroidal detachment, tube obstruction, and aqueous misdirection. It was uncertain which treatment resulted in more complications (Analysis 7.4).

8. Quality of life

Teixeira 2012 did not report on quality of life outcomes.

Ahmed implant modifications: Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation

Three studies investigated shunt augmentation for Ahmed implantation (Hwang 2004; Rho 2015; Yazdani 2016). Yazdani 2016 compared the Ahmed implant with amniotic membrane versus the Ahmed implant without amniotic membrane for glaucoma. The study enrolled a total of 75 participants (25 in the amniotic membrane group, 25 in the no amniotic membrane group, and 25 in a MMC group that was not included in this review). Twenty participants from the amniotic membrane group and 23 participants from the no amniotic membrane group were included in study analyses at 52 weeks' follow-up. Rho 2015 compared the Ahmed implant with biodegradable collagen matrix versus the Ahmed implant alone for glaucoma. The study enrolled a total of 43 eyes of 40 participants (22 eyes in the collagen matrix group and 21 eyes in the no collagen matrix group) and reported 6 months of follow-up data. Hwang 2004 compared the Ahmed implant with versus without pericardial surface expansion. The study enrolled 20 eyes of 17 participants (10 eyes in the pericardium group and 10 eyes in the no pericardium group). Follow-up was for a mean of 11.5 ± 5.1 months in the pericardium group and 14.9 ± 4.3 months in the no pericardium group. The groups without shunt augmentation were used as the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

Due to differences in the type of shunt augmentation used in each study and substantial statistical heterogeneity across studies (I^2 = 77%), we did not combine study results in meta-analysis. Mean IOP outcomes for individual studies are shown in Analysis 8.1.

Yazdani 2016 reported mean IOP outcomes at six months' and one-year follow-up. As only figures were available in the published study, we abstracted all data presented in this study using graph digitization software. The mean difference for IOP when comparing the Ahmed implant with amniotic membrane versus without

amniotic membrane was 0.20 mmHg (95% CI -2.71 to 3.11) at six months and 0.80 mmHg (95% CI -2.47 to 4.07) at one year.

Rho 2015 recorded mean IOP at the six-month follow-up visit. There was no difference in IOP (MD 0.00 mmHg, 95% CI -2.42 to 2.42) among participants who had an Ahmed implant plus biodegradable collagen matrix versus participants who had only the Ahmed implant.

Hwang 2004 reported a mean difference for IOP of -4.10 mmHg (95% CI -6.17 to -2.03) when comparing the Ahmed implant with versus without pericardial surface expansion.

We graded the certainty of evidence for mean IOP as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

IOP thresholds

Rho 2015 analyzed IOP thresholds, but we did not formally compare these outcomes in this review as IOP threshold data were averaged from all follow-up time points up to six months, without isolated data from the six-month follow-up time point.

Yazdani 2016 defined complete success as IOP between 6 and 21 mmHg without any antiglaucoma medications and partial success as IOP between 6 and 21 mmHg with up to two antiglaucoma drops. Hwang 2004 described surgical success as IOP between 5 and 22 mmHg without additional glaucoma surgery and without loss of light perception; surgical success was further divided into complete success (without antiglaucoma medications at last visit) and qualified success (with antiglaucoma medications at last visit). At six months, the summary RR when comparing shunt augmentation with no augmentation was 1.50 (95% CI 0.88 to 2.55) for complete success and 1.02 (95% CI 0.88 to 1.19) for qualified or complete success (Analysis 8.2). At one year, Yazdani 2016 reported the number of participants in the Ahmed implant with amniotic membrane group and the Ahmed implant without amniotic membrane group with complete and qualified success: RR 1.15 (95% CI 0.26 to 5.07) for complete success and RR 0.88 (95% CI 0.68 to 1.13) for qualified or complete success (Analysis 8.3). We graded the certainty of evidence for IOP thresholds as low, downgrading for risk of bias (-1) and imprecision (-1).

2. Visual acuity

None of these studies reported on visual acuity outcomes.

3. Postoperative hypertensive phase

Rho 2015 and Yazdani 2016 did not report on the postoperative hypertensive phase. Hwang 2004 reported that the hypertensive phase was present in 2/10 (20%) of participants with pericardial surface expansion and 8/10 (80%) of participants without pericardial surface expansion (RR 0.25, 95% CI 0.07 to 0.90; Analysis 8.4). We judged the certainty of the evidence to be low, downgrading for risk of bias (-1) and imprecision (-1).

4. Visual field

None of these studies reported on visual field outcomes.

5. Antiglaucoma medications

Yazdani 2016 did not report on the number of antiglaucoma medications used by participants. In Rho 2015, the number of antiglaucoma medications needed six months after surgery was less in the Ahmed implant plus collagen matrix group than in the Ahmed implant-only group (MD -1.10, 95% CI -1.66 to -0.54; Analysis 8.5). Hwang 2004 reported no significant difference in the mean number of antiglaucoma medications used six months postoperatively in the Ahmed implant plus pericardial surface expansion group and the Ahmed implant-only group (MD 0.30, 95% CI -0.17 to 0.77). We graded the certainty of the evidence as very low, downgrading for risk of bias (-1), heterogeneity (-1), and imprecision (-1).

6. Additional glaucoma surgery

Hwang 2004, Rho 2015, and Yazdani 2016 did not report on additional glaucoma surgery or reoperations.

7. Adverse events

Adverse events were reported in Rho 2015 at six months' follow-up and Yazdani 2016 at one-year follow-up; Hwang 2004 did not report on adverse events.

Rho 2015 reported that the following adverse events were reported by at least one participant in each treatment group at six months: early hypotony, hyphema, and choroidal effusion. The same number of participants in each group reported each complication (Analysis 8.6). No participants reported tube exposure, endophthalmitis, or wound leak.

At one year, the difference between the two groups in Yazdani 2016 was uncertain due to the low number of events for many of the reported complications (Analysis 8.7).

We graded the certainty of evidence for adverse events as very low, downgrading for risk of bias (-1) and imprecision (-2).

8. Quality of life

None of these studies reported on quality of life outcomes.

Ahmed implant modifications: Ahmed implant partial tube ligation versus Ahmed implant without tube ligation

One study compared the Ahmed implant with partial ligation of the tube versus with no ligation of the tube in participants with neovascular glaucoma (Kee 2001). The study enrolled 32 participants with 16 per group and reported 6 months of follow-up data. The Ahmed implant without ligation group was used as the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

At six months, the mean difference between groups was 0.40 mmHg (95% CI -3.70 to 4.50; Analysis 9.1). We graded the certainty of evidence for mean IOP as low, downgrading for risk of bias (-1) and imprecision (-1).

IOP thresholds

IOP threshold outcomes are summarized in Analysis 9.2. Kee 2001 defined complete success as IOP < 22 mmHg and > 5 mmHg for the last two visits with no additional glaucoma surgery and no antiglaucoma medication. Qualified success was defined as the same but with antiglaucoma medication. Ten of 16 participants (62.5%) in the ligation group achieved complete success, while 9 of 16 participants had complete success in the non-ligation group at 6 months (RR 1.11, 95% CI 0.63 to 1.97). Qualified or complete success

was achieved in 12 of 16 participants in each group (RR 1.00, 95% CI 0.67 to 1.49). We graded the certainty of evidence for IOP thresholds as low, downgrading for risk of bias (-1) and imprecision (-1).

2. Visual acuity

Kee 2001 did not report on visual acuity outcomes.

3. Postoperative hypertensive phase

Kee 2001 did not report on postoperative hypertensive phase.

4. Visual field

Kee 2001 did not report on visual field outcomes.

5. Antiglaucoma medications

Kee 2001 did not report on the number of antiglaucoma medications used by participants.

6. Additional glaucoma surgery

Kee 2001 did not report on additional glaucoma surgery or reoperations.

7. Adverse events

Complications reported at six months' follow-up are summarized in Analysis 9.3. The difference between the two groups was uncertain due to the low number of events for the reported complications. We graded the certainty of evidence for adverse events as very low, downgrading for risk of bias (-1) and imprecision (-2).

8. Quality of life

Kee 2001 did not report on quality of life outcomes.

Ahmed implant modifications: Pars plana Ahmed implant versus conventional Ahmed implant for glaucoma with penetrating keratoplasty

One study compared pars plana versus anterior chamber insertion of the Ahmed implant for participants with glaucoma who required concomitant penetrating keratoplasty (Parihar 2016). The study enrolled a total of 58 participants with 29 in each group and reported 2 years of follow-up data. The conventional (anterior chamber insertion) Ahmed group was used as the reference group.

1. Control of IOP

Mean IOP

The mean difference in IOP at two years' follow-up is presented in Analysis 10.1 (MD 1.20 mmHg, 95% CI -6.23 to 8.63). We graded the certainty of evidence for mean IOP as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

IOP thresholds

Parihar 2016 defined complete success and qualified success as IOP ≤ 21 mmHg or ≥ 5 mmHg without and with antiglaucoma medications, respectively. The difference between the two groups was uncertain for both complete success (RR 0.78, 95% CI 0.34 to 1.76) and qualified or complete success (RR 0.95, 95% CI 0.68 to 1.32) at two years (Analysis 10.2). We graded the certainty of evidence for IOP thresholds as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

2. Visual acuity

In Parihar 2016, 15 participants (60%) with pars plana clip-modified Ahmed implant and 14 participants (56%) with conventional Ahmed implant had visual acuity improvement of 2 lines or more on the Snellen chart at two years' follow-up (RR 1.07, 95% CI 0.67 to 1.72; Analysis 10.3). We graded the certainty of evidence as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

3. Postoperative hypertensive phase

Parihar 2016 did not assess the postoperative hypertensive phase.

4. Visual field

Parihar 2016 did not assess visual field outcomes.

5. Antiglaucoma medications

Parihar 2016 did not report on the number of antiglaucoma medications needed by participants after treatment.

6. Additional glaucoma surgery

Parihar 2016 did not report on participants' need for additional glaucoma surgery.

7. Adverse events

Postoperative complications in participants undergoing pars plana Ahmed implant and conventional Ahmed implant for glaucoma with penetrating keratoplasty are summarized in Analysis 10.4. The difference between the two groups was uncertain due to the low number of events for the reported complications. We graded the certainty of evidence for adverse events as very low, downgrading for risk of bias (-1), indirectness (-1), and imprecision (-1).

8. Quality of life

Parihar 2016 did not assess quality of life outcomes.

Ahmed implant modifications: Ahmed implant model M4 versus Ahmed implant model S2

One study compared the Ahmed implant model M4 (high-density porous polyethylene) with the Ahmed implant model S2 (polypropylene) for neovascular glaucoma (Gil-Carrasco 2016). The study enrolled a total of 42 participants with 21 in each group, and reported 1 year of follow-up data. The Ahmed model S2 group was used as the reference.

1. Control of IOP

Mean IOP

The mean IOP at six-month and one-year follow-up is reported in Analysis 11.1. At six months' follow-up, the mean IOP was higher in the Ahmed implant model M4 group compared with the Ahmed implant model S2 group (MD 6.80, 95% CI 2.23 to 11.37); there was no statistically significant difference between the two groups at one-year follow-up (MD 2.52, 95% CI -3.60 to 8.64). We graded the certainty of evidence for mean IOP at six months as moderate, downgrading for risk of bias (-1), and at one year as low, downgrading for risk of bias (-1) and imprecision (-1).

IOP thresholds

Gil-Carrasco 2016 assessed no IOP thresholds.

2. Visual acuity

Gil-Carrasco 2016 reported that at 1-year follow-up, 5 participants in the Ahmed implant model M4 group and 7 participants in the Ahmed implant model S2 group had vision between 20/20 and 20/100 (RR 0.71, 95% CI 0.27 to 1.89; Analysis 11.2). We graded the certainty of evidence for visual acuity as low, downgrading for risk of bias (-1) and imprecision (-1).

3. Postoperative hypertensive phase

Gil-Carrasco 2016 did not report on the postoperative hypertensive phase.

4. Visual field

Gil-Carrasco 2016 did not examine visual field outcomes.

5. Antiglaucoma medications

Gil-Carrasco 2016 reported that at 1-year follow-up, there were 5 participants using no additional antiglaucoma medications, 7 participants using two additional antiglaucoma medications, and 6 participants using three additional antiglaucoma medications in the Ahmed implant model M4 group. In the Ahmed implant model S2 group, there was 1 participant using no additional treatment, 1 using one medication, 4 using two medications, and 15 using three medications.

6. Additional glaucoma surgery

Gil-Carrasco 2016 did not report on participants' need for additional glaucoma surgery.

7. Adverse events

The complications reported by participants one day after surgery in Gil-Carrasco 2016 are presented in Analysis 11.3. The Ahmed M4 group had 7 total complications, and the Ahmed S2 group had 8, however the estimate was uncertain (RR 0.88, 95% CI 0.39 to 1.98). We graded the certainty of evidence for adverse events as low, downgrading for risk of bias (-1) and imprecision (-1).

8. Quality of life

Gil-Carrasco 2016 did not report on quality of life measures.

Baerveldt implant modifications: 500 mm² Baerveldt implant versus 350 mm² Baerveldt implant

One study compared the 500 mm² Baerveldt implant with the 350 mm² Baerveldt implant for non-neovascular glaucoma (Britt 1999). The study included 103 participants, with 53 in the 500 mm² Baerveldt group and 50 in the 350 mm² Baerveldt group. Outcomes were reported for up to five years of follow-up. The 350 mm² Baerveldt group was the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

Mean IOP outcomes at 1, 3, and 5 years' follow-up are summarized in Analysis 12.1. The mean difference in IOP was 0.50 mmHg (95% CI -3.15 to 4.15) at one-year follow-up; -1.50 mmHg (95% CI -3.55 to 0.55) at three years' follow-up; and -0.60 mmHg (95% CI -3.93 to 2.73) at five years' follow-up. We graded the certainty of evidence for mean IOP outcomes as low, downgrading for risk of bias (-1) and imprecision (-1).

IOP thresholds

Britt 1999 defined surgical success as IOP ≥ 6 mmHg and ≤ 21 mmHg with or without medication. Intermediate study results at 6 to 18 months' follow-up showed a larger proportion of surgical success in the 500 mm² Baerveldt group than in the 350 mm² Baerveldt group (RR 2.67, 95% CI 1.06 to 6.73; Analysis 12.2). At five years' follow-up, there was a smaller proportion of surgical success in the 500 mm² Baerveldt group than in the 350 mm² Baerveldt group (RR 0.81, 95% CI 0.65 to 0.99; Analysis 12.2). We graded the certainty of evidence for these outcomes as low, downgrading for risk of bias (-1) and imprecision (-1).

2. Visual acuity

Britt 1999 did not report visual acuity outcomes.

3. Postoperative hypertensive phase

Britt 1999 did not assess the postoperative hypertensive phase.

4. Visual field

Britt 1999 did not report on visual field outcomes.

5. Antiglaucoma medications

Britt 1999 reported that the number of required antiglaucoma medications was comparable between groups throughout the five-year study period, except for the second year, when the 500 mm² Baerveldt group required significantly fewer antiglaucoma medications compared with the 350 mm² Baerveldt group (P = 0.02).

6. Additional glaucoma surgery

Britt 1999 did not report on the need for additional glaucoma surgery after treatment.

7. Adverse events

Britt 1999 reported complications associated with the 500 mm² and the 350 mm² Baerveldt implants. Similar numbers of participants in each group experienced the following complications: diplopia/strabismus, anterior uveitis, retinal detachment, and tube obstruction (Analysis 12.3). We graded the certainty of evidence for adverse events as low, downgrading for risk of bias (-1) and imprecision (-1).

8. Quality of life

Britt 1999 did not assess quality of life outcomes.

Molteno implant modifications: Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant without oral corticosteroids

One trial compared the single-plate Molteno implant with oral corticosteroids to the single-plate Molteno implant without oral corticosteroids for glaucoma (Valimaki 1999). The trial enrolled 21 participants, with 10 in the Molteno with steroids group and 11 in the Molteno without steroids group, and reported outcomes at 6 months' follow-up. The Molteno without steroids group was the reference for all analyses in this comparison.

1. Control of IOP

Mean IOP

The mean difference in IOP at six months was 0.0 mmHg (95% CI -4.75 to 4.75; Analysis 13.1). We graded the certainty of evidence for mean IOP as low, downgrading for risk of bias (-1) and imprecision (-1).

IOP thresholds

Valimaki 1999 defined surgical success as IOP between 6 mmHg and 22 mmHg with fewer or an equal number of antiglaucoma medications taken preoperatively and no additional surgery. Five (50%) of participants in the Molteno with steroids group and 9 (83%) in the Molteno implant without steroids group were classified as surgical successes at 6 months' follow-up (RR 0.61, 95% CI 0.31 to 1.21; Analysis 13.2). We graded the certainty of evidence for IOP thresholds as low, downgrading for risk of bias (-1) and imprecision (-1).

2. Visual acuity

Valimaki 1999 reported on visual acuity using the Snellen chart. Visual acuity remained within 1 line of preoperative level or improved in all eyes that received the Molteno implant plus steroids and 82% of eyes that received the Molteno implant without steroids (RR 1.21, 95% CI 0.88 to 1.66; Analysis 13.3). We graded the certainty of evidence for visual acuity as low, downgrading for risk of bias (-1) and imprecision (-1).

3. Postoperative hypertensive phase

Valimaki 1999 did not assess the postoperative hypertensive phase.

4. Visual field

Valimaki 1999 did not assess visual field outcomes.

5. Antiglaucoma medications

There was a trend showing that participants in the Molteno implant with steroids group required more glaucoma medications compared with participants in the Molteno implant without steroids group at six months (MD 0.8, 95% CI 0.00 to 1.60; Analysis 13.4). We graded the certainty of evidence for this outcome as low, downgrading for risk of bias (-1) and imprecision (-1).

6. Additional glaucoma surgery

Four (40%) of participants in the Molteno implant with steroids group and 2 (18.2%) in the Molteno implant without steroids group needed repeat surgery including needling of Molteno bleb or a second Molteno implantation (RR 2.20, 95% CI 0.51 to 9.53; Analysis 13.5). We graded the certainty of evidence for this outcome as low, downgrading for risk of bias (-1) and imprecision (-1).

7. Adverse events

Intraoperative and postoperative complications are summarized in Analysis 13.6. Due to the small sample size and low number of events for many reported complications, the difference between groups for adverse events was uncertain. We graded the certainty of evidence for adverse events as low, downgrading for risk of bias (-1) and imprecision (-1).

8. Quality of life

Valimaki 1999 did not report on quality of life measures.

Molteno implant modifications: Double-plate Molteno implant versus single-plate Molteno implant

One study compared the double-plate Molteno implant to the single-plate Molteno implant for non-neovascular glaucoma (Heuer 1992). We did not include data from this study in formal analyses due to unreliable reporting of follow-up times. The study enrolled 132 participants, though only 31 participants underwent the first stage of two-stage installations, and it was unclear how they were included in analyses.

Molteno implant modifications: Pressure-ridge Molteno implant versus double-plate Molteno implant with tube ligation

One study compared the pressure-ridge Molteno implant with the standard Molteno implant with tube ligation for glaucoma (Gerber 1997). We did not include data from this study in formal analyses as no standard deviations were reported for continuous outcomes, and few outcomes were reported overall. The study enrolled 30 participants with 15 in each group and reported outcomes up to 12 weeks.

DISCUSSION

Summary of main results

This was a comprehensive review of randomized controlled trials of aqueous shunts for glaucoma. The 27 studies included in this review involved a wide variety of participants, interventions, and outcome measures related to the surgical management of glaucoma.

Comparison of aqueous shunts versus trabeculectomy

Four trials compared Ahmed or Baerveldt aqueous shunts with trabeculectomy (Pakravan 2007; TVT 2009; Wilson 2000; Wilson 2003). Very low-certainty evidence from three trials with one-year follow-up showed that IOP was higher in the aqueous shunt groups than in the trabeculectomy groups. Due to a high amount of statistical imprecision, potential risks of bias, and heterogeneity among trials, we could draw no conclusive findings for this comparison based on the outcomes of our review. The question of the effectiveness of aqueous shunts versus trabeculectomy for glaucoma management has not been clearly resolved, especially in terms of outcomes relevant to patients such as preservation of vision and reduction of glaucoma medication use. After the completion of this review, the TVT study published quality of life outcomes; these findings were not included in the present version of this review but will be included in the five-year review update.

An important consideration in this area of study is the use of mitomycin C (MMC). In two trials comparing the Ahmed implant with trabeculectomy (Wilson 2000; Wilson 2003), MMC was used at the discretion of the surgeon. Participants who did not receive MMC may have had different underlying risks compared with participants who received MMC. In another trial, the Baerveldt implant was compared with trabeculectomy plus MMC (TVT 2009). A disproportionate number of participants in the trabeculectomy plus MMC group were classified as failures due to hypotony (31% in the trabeculectomy group versus 13% in the tube group), which may have been related to the higher dose and longer duration of MMC usage in the TVT 2009 study (0.4 mg/mL for 4 minutes) compared with other clinical settings (Caprioli 2011; Fontana 2006a; Fontana 2006b; Zahid 2013).

A notable finding was the high proportion of participants with persistent diplopia in the Baerveldt group compared with the proportion with diplopia in the trabeculectomy group at all three time points of follow-up in the TVT 2009 study. In the Baerveldt group, the proportion of participants with diplopia after Baerveldt implantation in the TVT 2009 study was lower than the proportion of participants with diplopia after Baerveldt implantation in the ABC 2011 study and higher than the proportion in the AVB 2011 study. Rates of diplopia after Baerveldt implantation in retrospective studies have varied widely, however no previous trials other than TVT 2009 have compared the risk of diplopia in participants with tube shunt implantation versus trabeculectomy. The large discrepancy in diplopia risk between the Baerveldt and trabeculectomy groups in the TVT 2009 study is concerning and suggests that caution should be taken to avoid this serious complication.

Comparison of aqueous shunts to each other

A meta-analysis of two trials suggests that the Baerveldt implant achieved greater IOP reduction at one year compared with the Ahmed implant (ABC 2011; AVB 2011), though it is unclear whether the 2 to 4 mmHg mean difference in IOP is clinically significant. Any difference between the two shunts was uncertain in terms of visual acuity outcomes. The Ahmed group had a higher proportion of participants who required reoperation to control glaucoma progression; the mean difference in the number of antiglaucoma medications was less than one between groups. There were similar rates of all complications in both groups including hypotony maculopathy and postoperative motility disturbances, however the number of events was small and therefore the imprecision of results was high. Based on the findings from the ABC 2011 and AVB 2011 studies, there is some evidence that the Baerveldt shunt may provide more IOP reduction and less risk of reoperation than the Ahmed shunt. After the completion of this review, the AVB study published five year treatment outcomes; these findings were not included in the present version of this review but will be included in the five-year review update.

One trial compared the Ahmed implant to the single-plate Molteno implant for glaucoma (Nassiri 2010). Low-certainty evidence suggests that the Ahmed shunt, when compared with the Molteno shunt, provides less IOP reduction, but it was unclear whether the 1 to 3 mmHg mean difference in IOP is clinically significant. Nassiri 2010 was one of the few included studies that reported visual field outcomes, though these outcomes may not be meaningful with only 24 months of follow-up. Based on this trial, it was unclear if either implant demonstrated superiority for the management of glaucoma.

Two studies compared the double-plate Molteno implant with the Schocket shunt (Smith 1992; Wilson 1992), though we did not combine results due to significant heterogeneity between the trials. Both studies had several limitations, which included providing no specific time points of follow-up or reporting six-month outcomes when 12-month follow-up was planned. In light of these limitations and the heterogeneity between the two studies, we could make no definitive conclusions from the findings of either study.

Comparison of aqueous shunts with and without modifications

A meta-analysis of two trials evaluated the use of early aqueous suppression when IOP reached more than 10 mmHg after Ahmed valve implantation compared with standard medical management after Ahmed valve implantation (Law 2016; Pakravan 2014). Early aqueous suppression was associated with greater IOP reduction at six months, but not at one-year follow-up. Participants in the early-suppression group did not require more medications over long-term follow-up compared with participants without early suppression. Visual acuity, time to onset of the hypertensive phase, mean duration of the hypertensive phase, and proportions of participants with complications were similar between the two groups. These findings suggest that early aqueous suppression may be a favorable modification to current clinical practice for the postoperative management of people receiving Ahmed valves for the control of disease progression through consistent IOP reduction.

Four studies compared any anti-vascular endothelial growth factor (anti-VEGF) agent with no anti-VEGF agent in combination with the Ahmed implant (Arcieri 2015; Desai 2013; Mahdy 2013; Rojo-Arnao 2011). Due to differences in interventions and substantial statistical heterogeneity (greater than 90%), we did not combine individual study results in meta-analysis. One study that included only participants with neovascular glaucoma and used panretinal photocoagulation in both groups reported favorable results for intravitreal bevacizumab versus no intravitreal bevacizumab (Mahdy 2013). The other three studies showed mixed results; we could draw no conclusions from these studies due to the variability in findings and low certainty of evidence.

Two studies evaluated the Ahmed implant with versus without corticosteroids (Teixeira 2012; Yuen 2011). Yuen 2011 reported outcomes at only 12 weeks of follow-up, which we considered too short for analysis. In Teixeira 2012, the small number of participants led to imprecise results with wide confidence intervals.

Three studies compared shunt augmentation for Ahmed implantation (Hwang 2004; Rho 2015; Yazdani 2016). Due to differences in interventions and substantial statistical heterogeneity, we did not combine individual study results in meta-analysis. The three studies showed mixed results; we could draw no firm conclusions from these studies due to the variability in findings and low certainty of evidence.

One study each compared the Ahmed implant with partial ligation of the tube versus with no ligation of tube in participants with neovascular glaucoma (Kee 2001); the Ahmed implant inserted pars plana versus in the anterior chamber for participants with glaucoma who required concomitant penetrating keratoplasty (Parihar 2016); the Ahmed implant model M4 versus the Ahmed implant model S2 for neovascular glaucoma (Gil-Carrasco 2016); the 500 mm^2 Baerveldt implant versus the 350 mm^2 Baerveldt implant for non-neovascular glaucoma (Britt 1999); the single-plate Molteno implant with oral corticosteroids versus the single-plate Molteno implant without oral corticosteroids for glaucoma (Valimaki 1999); the double-plate Molteno implant versus the single-plate Molteno implant for non-neovascular glaucoma (Heuer 1992); and the pressure-ridge Molteno implant versus the standard Molteno implant with tube ligation for glaucoma (Gerber 1997). Limitations in these studies, such as the lack of reporting of outcomes or follow-up times, small sample sizes, and high risks of bias, precluded us from drawing clinically meaningful conclusions.

Overall completeness and applicability of evidence

The studies in this review compared a broad range of interventions, participants, diagnoses, and outcomes. All but one trial reported mean IOP (Kee 2001), and 20 trials provided a dichotomized IOP definition of surgical success, though none of these definitions were consistent with our a priori definition of success. Most trials in this review used an IOP of 5 mmHg as the lower limit and 21 mmHg as the upper limit of success, but these parameters may need to be revised as the lower limit is arbitrary and the upper limit does not necessarily represent a clinically relevant level of IOP control.

Other outcomes compared in the included trials were visual acuity, visual field, mean number of glaucoma medications, complication rates, and reoperation. The completeness of the types of outcomes assessed was inconsistent across studies, though we were able to meta-analyze several outcomes for interventions of significant interest such as the Ahmed implant versus the Baerveldt implant.

The majority of studies in this review included adult participants of all ages with many subtypes of glaucoma, and are generalizable to adult participants who undergo glaucoma surgery in the real world. One exception is TVT 2009, which included only participants with previous trabeculectomy or cataract surgery and may thus be less generalizable. One issue with the overall applicability of this review is that a large variety of interventions were analyzed, with very few studies that analyzed the same intervention that were amenable to meta-analysis. For improved understanding of the optimal surgical management of glaucoma, it would be beneficial to conduct further trials with comparisons that are relevant to current clinical practice, which include aqueous shunts versus trabeculectomy with MMC and the Ahmed implant versus the Baerveldt implant.

Quality of the evidence

The certainty of the evidence was generally low across comparisons included in this review. The most common reasons for downgrading the evidence were imprecision of results and high risk of bias. Many studies reported appropriate randomization methods, though allocation concealment was not reported in most studies. Given that several interventions involved different types of surgery in the two study groups, masking was not possible in all studies. A major flaw was that most studies did not use a strict intention-to-treat analysis and excluded participants from analyses after they were lost to follow-up. Furthermore, few meta-analyses were possible due to the heterogeneity in interventions evaluated, outcomes reported, and length of time participants were followed. The results reported in this review were influenced by these methodological limitations, therefore the evidence must be interpreted with caution.

Potential biases in the review process

All steps of the review were completed by at least two review authors to reduce bias during study selection, 'Risk of bias' assessment, and data extraction. We conducted a highly sensitive search of the literature to best identify all studies eligible for this review.

Agreements and disagreements with other studies or reviews

The original version of this review was published in the Cochrane Library in January 2006 and included 15 trials (Minckler 2006). The current review has revised inclusion criteria and now includes 27 trials, of which 10 trials were also included in the previous review. Many of the studies in this updated review included different comparisons than those in the original review and thus did not impact the results of the original publication; the more recent studies compared newer models of aqueous shunt devices and included head-to-head comparisons of aqueous shunt devices.

Outside of Cochrane reviews, one systematic review compared the Ahmed implant to trabeculectomy with or without MMC for glaucoma (HaiBo 2015). This review included a combination of prospective and retrospective studies and analyzed six studies with a total of 507 eyes. Unlike our present review, this review reported that the Ahmed implant was equivalent to trabeculectomy for reduction of IOP and reduction of glaucoma medication usage, and that the Ahmed implant was associated with a lower frequency of adverse events compared with trabeculectomy. The HaiBo 2015 review is limited by its inclusion of retrospective studies with variable duration of follow-up, and is also potentially biased by its inclusion of a study that only included participants with neovascular glaucoma, as these patients are known to have higher risks of complications and poorer outcomes overall compared with people with non-neovascular glaucoma.

Another systematic review outside of Cochrane compared the Ahmed implant with intravitreal bevacizumab to the Ahmed implant alone for neovascular glaucoma (Hwang 2015). This review included both prospective and retrospective studies and a total of six studies with 256 eyes. Similar to the present review, it reported that the Ahmed implant with adjunctive bevacizumab was more effective than the Ahmed implant alone for IOP reduction in people with neovascular glaucoma. Results from this review are potentially limited by its inclusion of retrospective studies with variable follow-up.

AUTHORS' CONCLUSIONS

Implications for practice

Findings from this study suggest several relevant implications for clinical practice. Trabeculectomy traditionally has been considered the standard surgery for glaucoma that cannot be managed by medical therapy alone. Studies in this review that compared aqueous shunts with trabeculectomy suggest that trabeculectomy is an equivalent if not better choice for the overall management of glaucoma that is not controlled by maximally tolerated medical therapy.

Studies that compared the Ahmed implant to the Baerveldt implant suggest that the Baerveldt implant may provide more intraocular pressure (IOP) reduction and result in fewer additional surgeries one year after the implant. However, when a wide range of patient-important outcomes are taken into account, including IOP reduction, visual acuity, medication use, complications, and reoperation, it is unclear if one implant is superior to another.

Another notable finding from this review is the possible benefit of early initiation of aqueous suppression at lower IOP levels after Ahmed valve placement for more effective long-term IOP control. Finally, for people with neovascular glaucoma, adjunctive intravitreal anti-vascular endothelial growth factor therapy with aqueous shunt placement appears to provide a benefit for

long-term IOP control and minimization of complications and reoperation.

Implications for research

This review raises several issues for future trials of glaucoma surgery. Clinically, future trials should include standardized definitions of success that reflect greater levels of IOP reduction than the current definitions of success included in studies in this review. Standardized definitions of the hypertensive phase would also increase comparability across studies. Several outcomes that were underinvestigated in this study are also important and deserve more attention in future trials: visual field progression, duration or time to onset of the postoperative hypertensive phase, reoperation for glaucoma, and quality of life.

Methodologically, there are several modifications that future trials could make to minimize bias. Specifically, trials would benefit from standardized methods for allocation concealment and from the clear reporting of these methods, as almost no studies in this review reported on allocation concealment. Additionally, studies could decrease bias by following an intention-to-treat analysis and by including all randomized participants in all analyses from all follow-up time points, and use of multiple imputation methods for missing data when necessary. It would also be beneficial to increase the sample size in trials to make subgroup analyses possible. Finally, masking of the surgeon to the intervention is not possible for most comparisons, however masking of outcome assessors could be done for certain measurements such as IOP or visual acuity.

In conclusion, the role of aqueous shunts in the surgical management of glaucoma is a complicated and controversial subject. With the increasing use of aqueous shunts worldwide, further adequately powered trials that compare aqueous shunts to each other and to other types of surgical interventions for glaucoma are needed for improved patient care.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

ABC 2011

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 286 total participants; 143 in the Ahmed glaucoma valve (AGV) group, 133 in the Baerveldt glaucoma implant (BGI) group, and 10 withdrew consent prior to surgery and were dropped from the study **Unit of analysis:** individual (1 study eye per person) **Number analyzed:** at 1 year: 249 total (132 AGV, 117 BGI); at 3 years: 206 total (106 AGV, 100 BGI); at 5 years: 174 total (87 AGV, 87 BGI) **Losses to follow-up:** at 1 year: 27 total (11 AGV, all missed follow-up visit; 16 BGI, 3 died and 13 missed follow-up visit) at 3 years: 70 total (37 AGV, 6 died and 31 missed follow-up visit; 33 BGI, 4 died and 29 missed follow-up visit) at 5 years: 102 total (56 AGV, 12 died and 44 missed follow-up visit; 46 BGI, 9 died and 37 missed follow-up visit) **Handling of missing data:** participants who dropped out were excluded from certain analyses

ABC 2011 *(Continued)*

Participants	**Country:** Brazil, Canada, Singapore, UK, USA **Age (years at baseline):** Mean ± SD in AGV group: 65.4 ± 12.8 (n = 143); mean ± SD in BGI group: 62.2 ± 14.2 (n = 133) **Gender:** 73 (51%) men and 70 (49%) women in the AGV group; 70 (53%) men and 63 (47%) women in the BGI group **Inclusion criteria:** Age 18 to 85 years, inclusive; glaucoma inadequately controlled on tolerated medical therapy with intraocular pressure greater than or equal to 18 mmHg; glaucoma drainage implant as planned surgical procedure; primary open-angle glaucoma with previous failed trabeculectomy or other intraocular surgery; secondary glaucoma with or without previous intraocular surgery **Exclusion criteria:** Unwilling or unable to give consent or unwilling to accept randomization; participant out of area and potentially unavailable for follow-up visits; no light perception; uveitis secondary to juvenile idiopathic arthritis; previous cyclodestructive procedure or previous aqueous shunt device implanted in the same eye; superotemporal buckling or other external impediment to superotemporal aqueous shunt implantation; silicone oil-filled eyes or sufficient residual intraocular silicone oil to preclude superotemporal aqueous shunt implantation; vitreous sufficient to require a vitrectomy present in the anterior chamber at the time of surgery; nanophthalmos, Sturge-Weber syndrome, or other conditions associated with elevated episcleral venous pressure; required combination surgery **Equivalence of baseline characteristics:** No significant differences in any of the demographic features were observed between the AGV group and the BGI group, except for a 13% higher prevalence of hypertension in the AGV group (P = 0.039); no significant differences in ocular characteristics at baseline **Diagnoses in participants:** Primary open-angle glaucoma; primary angle-closure glaucoma; neovascular glaucoma; uveitic glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP7 **Intervention 2:** 350 mm^2 Baerveldt glaucoma implant, model 101-350 **General treatment:** Critical surgical procedures were standardized between groups (e.g. all shunts were implanted in the supratemporal quadrant); other parts of the procedure were left to the surgeons' discretion (e.g. use of a viscoelastic at the conclusion of surgery) **Length of follow-up:** 5 years
Outcomes	**Primary outcomes:** • Complete success: IOP ≤ 21 mmHg and > 5 mmHg and reduced by at least 20% from baseline with no adjunctive medications • Qualitifed success: IOP ≤ 21 mmHg and > 5 mmHg and reduced by at least 20% from baseline with adjunctive medications • Failure: IOP > 21 mmHg or less than a 20% reduction from baseline on 2 consecutive study visits after 3 months; IOP ≤ 5 mmHg on 2 consecutive study visits after 3 months; reoperation for glaucoma; loss of light perception vision; or removal of the implant for any reason **Secondary outcomes:** • Mean IOP • Rate of surgical complications • Number of glaucoma medications • Snellen visual acuity • Reoperations for glaucoma • Reoperations for complications • Frequency of cataract surgery **Reported adverse effects:** Yes

ABC 2011 *(Continued)*

	Other details about outcome assessment: Outcomes were assessed at postoperative day 1, week 1, months 1, 3, 6, 12, and 18, and years 2, 3, 4, and 5; an independent Safety and Data Monitoring Committee monitored the conduct of the study annually; the Statistical Coordinating Center managed all study data, co-ordinates activities at the clinical centers, and monitors adherence to the study protocol; the Steering Committee had overall responsibility for directing activities and formulating policy for the study; surgeons were selected based on the satisfactory standard including previous surgical experience with each implant
Notes	**Type of study:** Published **Funding:** Supported by the National Institutes of Health, Bethesda, Maryland (grant no.: P30 EY014801) and unrestricted grants from New World Medical, Rancho Cucamonga, California and Research to Prevent Blindness, Inc., New York, New York **Study period:** Enrollment between October 2006 and April 2008; study start date was November 2005, and participants were followed up for 5 years **Reported subgroup analyses:** Dichotomous IOP outcomes were reported by glaucoma subtype (primary, secondary, neovascular, uveitic)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization using permuted block design stratified by clinical center and glaucoma diagnosis
Allocation concealment (selection bias)	Low risk	Randomization was performed by Statistical Coordinating Center after informed consent was obtained for participation.
Masking of outcome assessment (detection bias) Primary outcome	High risk	"Neither the subject nor the investigator could be masked to the randomization assignment"; "This is an unmasked study, and study visit measurements and outcome measures will be judged by participating physicians"
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	"Neither the subject nor the investigator could be masked to the randomization assignment"; "This is an unmasked study, and study visit measurements and outcome measures will be judged by participating physicians"
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported; the study design and methods were published in a companion article.
Other bias	High risk	Funded in part by New World Medical, makers of the Ahmed glaucoma valve

Arcieri 2015

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person)

Arcieri 2015 *(Continued)*

	Number randomized: 40 total participants; 20 in the Ahmed with intravitreal bevacizumab (IVB) group and 20 in the Ahmed without IVB group **Unit of analysis:** individual (1 study eye per person) **Number analyzed:** 40 total (20 Ahmed with IVB, 20 Ahmed without IVB) **Losses to follow-up:** not specified in paper; intraocular pressure data was available for 26 participants (14 in the Ahmed with IVB group and 12 in the Ahmed without IVB group) at 2 years' follow-up **Handling of missing data:** analysis excluded participants lost to follow-up
Participants	**Country:** Brazil **Age (years at baseline):** Mean ± SD in Ahmed with IVB group: 59.25 ± 8.05 (n = 20); mean ± SD in Ahmed without IVB group: 62.40 ± 11.78 (n = 20) **Gender:** 13 (65%) men and 7 (35%) women in the Ahmed with IVB group; 11 (55%) men and 9 (45%) women in the Ahmed without IVB group **Inclusion criteria:** Age over 18 years; uncontrolled neovascular glaucoma defined as IOP > 22 mmHg on maximum medical therapy; followed on glaucoma service University of Campinas, University of Sao Paolo, or Federal University of Uberlandia; underwent panretinal photocoagulation at least 2 weeks prior to enrollment **Exclusion criteria:** No light perception; neovascular glaucoma secondary to intraocular tumor or uveitis; unwilling or unable to return for follow-up; pregnancy; learning difficulties, mental illness, or dementia; previous cyclodestructive procedure, scleral buckle, or silicone oil surgery **Equivalence of baseline characteristics:** No significant differences in any demographic or clinical features observed at baseline between the 2 study groups **Diagnoses in participants:** Neovascular glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with IVB injected at the end of the surgical procedure and 4 and 8 weeks postoperatively **Intervention 2:** Ahmed glaucoma valve, model unspecified, with IVB withheld **General treatment:** 1-stage Ahmed glaucoma valve implantation using standard surgical technique with donor scleral graft, viscoelastic injection at end of procedure at surgeon discretion; pars plana injection of 0.05 mL of 25 mg/mL bevacizumab with 1.00-milliliter syringe attached to 30-gauge needle **Length of follow-up:** 2 years
Outcomes	**Primary outcomes:** • Success: IOP 6 to 21 mmHg with or without glaucoma medications and IOP reduction by at least 30% relative to preoperative values • Failure: Eyes requiring additional glaucoma surgery that developed phthisis or with loss of light perception **Secondary outcomes:** • Mean IOP • Number of glaucoma medications • Rate of surgical complications **Reported adverse effects:** Yes **Other details about outcome assessment:** Outcomes were assessed at postoperative day 1, weeks 1 and 2, months 1, 3, 6, 12, 18, and 24; no safety monitoring described in paper

Arcieri 2015 *(Continued)*

Notes	**Type of study:** Published **Funding:** Not described **Study period:** Enrollment period not described; participants followed for 24 months **Reported subgroup analyses:** None

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization performed using computer-generated randomization table.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Surgeons performing IVB injections not masked to intervention, but ophthalmologists responsible for participant follow-up were masked to use of IVB.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Surgeons performing IVB injections not masked to intervention, but ophthalmologists responsible for participant follow-up were masked to use of IVB.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in paper were reported.
Other bias	Low risk	No other risk of bias identified.

AVB 2011

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 238 total participants; 124 in the Ahmed glaucoma valve (AGV) group and 114 in the Baerveldt glaucoma implant (BGI) group **Unit of analysis:** individual (1 study eye per person) **Number analyzed:** at 1 year: 228 total (120 AGV, 108 BGI); at 3 years: 191 total (101 AGV, 90 BGI) **Losses to follow-up:** at 1 year: 23 total (14 AGV, 3 died and 11 missed visit or lost to follow-up; 9 BGI, 4 died and 5 missed visit or lost to follow-up) at 3 years: 47 total (23 AGV, 5 died and 18 missed visit or lost to follow-up; 24 BGI, 11 died and 13 missed visit or lost to follow-up)

AVB 2011 *(Continued)*

	Handling of missing data: some excluded from analysis and some imputed; methods for imputing data were not reported
Participants	**Country:** USA, Canada, and Chile **Age (years at baseline):** Mean ± SD in AGV group: 65 ± 17 (n = 124); mean ± SD in BGI group: 67 ± 15 (n = 114) **Gender:** 65 (52%) men and 59 (48%) women in the AGV group; 41 (36%) men and 73 (64%) women in the BGI group **Inclusion criteria:** Older than 18 years of age; inadequately controlled glaucoma refractory to conventional medicinal, laser, and surgical therapy; willing and able to provide informed consent and adhere to the study requirements including implant randomization and follow-up; people with significant conjunctival scarring or high-risk disease such as active neovascular glaucoma precluding antimetabolite trabeculectomy **Exclusion criteria:** People requiring an additional surgical procedure at the time of device implantation including phacoemulsification or corneal transplant; no light perception vision; enrollment of contralateral eye **Equivalence of baseline characteristics:** Yes, except proportion of women in the Baerveldt group was significantly greater than that in the Ahmed group (64% vs 48%, P = 0.011) **Diagnoses in participants:** Open-angle glaucoma, neovascular glaucoma, uveitic glaucoma, chronic angle-closure glaucoma, traumatic glaucoma, combined mechanism glaucoma, congenital glaucoma, glaucoma associated with penetrating keratoplasty
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP7 **Intervention 2:** 350 mm^2 Baerveldt glaucoma implant **General treatment:** Surgical procedures standardized according to AVB manual, all implants were placed in the superotemporal quadrant with scleral, corneal, or pericardial graft; no eyes were patched after surgery; all participants received antibiotic and steroid eye drops; cycloplegic use was left to the discretion of the surgeon **Length of follow-up:** Planned: 5 years (ongoing); actual: 3-year report published
Outcomes	**Primary outcomes:** • Complete success: IOP 5 to 18 mmHg and reduced by ≥ 20% from baseline at every visit after 3 months, no glaucoma medications, no vision-threatening complications, no additional surgical interventions, and no vision loss more than doubling of logMAR (approximately 2 Snellen lines) • Qualified success: No 2 consecutive visits after 3 months where IOP is < 5 mmHg, > 18 mmHg, or reduction is < 20% from baseline with or without glaucoma medications; no vision-threatening complications; no additional glaucoma procedures except surgical or laser interventions to correct non-vision-threatening complications (e.g. tube irrigation or repositioning); and no progression to no light perception vision • Failure: IOP > 18 mmHg, < 5 mmHg, or less than a 20% reduction from baseline on 2 consecutive study visits after 3 months, additional glaucoma surgery required including device explant, vision-threatening complications, or loss of light perception vision **Secondary outcomes:** • Mean IOP • Number of glaucoma medications • Visual acuity • Complications of surgery • Interventions following surgery • Non-glaucomatous complications and interventions

AVB 2011 *(Continued)*

	Reported adverse effects: Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at baseline, day 1, weeks 1 and 2, months 1, 2, 3, 6, 12, and 18, and years 2, 3, 4, and 5; the data were checked for accuracy by the Data Monitoring and Statistical Coordinating Center
Notes	**Type of study:** Published **Funding:** The Glaucoma Research Society of Canada, Toronto, Canada (IIA, PGC); departmental challenge grant from Research to Prevent Blindness, Inc. New York, NY (JCT) **Study period:** Enrollment between October 2005 and March 2009, start date July 2005, planned 5 years of follow-up **Reported subgroup analyses:** None

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The decision to place an Ahmed-FP7 valve or a Baerveldt-350 implant was made by the research site coordinator using a coin toss witnessed by the performing surgeon"
Allocation concealment (selection bias)	Low risk	"After patient eligibility and written informed consent were obtained" allocation was determined by coin toss.
Masking of outcome assessment (detection bias) Primary outcome	High risk	Open-label study; study investigators were not masked
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Open-label study; study investigators were not masked
Incomplete outcome data (attrition bias) Primary outcome	Low risk	Intention-to-treat analysis was followed.
Incomplete outcome data (attrition bias) Secondary outcomes	Low risk	Intention-to-treat analysis was followed.
Selective reporting (reporting bias)	Low risk	Study protocol was available, and prespecified outcomes were reported.
Other bias	Low risk	No other risk of bias identified.

Britt 1999

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 107 total participants; 55 in the 350 mm^2 Baerveldt group and 52 in the 500 mm^2 Baerveldt group **Unit of analysis:** individual (1 study eye per person)

Britt 1999 *(Continued)*

	Number analyzed: 103 total (53 in the 350 mm^2 Baerveldt group and 50 in the 500 mm^2 Baerveldt group) **Losses to follow-up:** 4 total (2 in each group) **Handling of missing data:** analysis excluded participants lost to follow-up
Participants	**Country:** USA **Age (years at baseline):** Mean ± SD in 350 mm^2 Baerveldt group: 67.5 ± 18.0 (n = 53); mean ± SD in 500 mm^2 Baerveldt group: 68.9 ± 16.7 (n = 50) **Gender:** Not reported **Inclusion criteria:** Medically uncontrollable glaucoma associated with aphakia, pseudophakia, or failed filtering procedures **Exclusion criteria:** Age younger than 12 years, neovascular glaucoma, uveitis, previous muscle surgery, extensive scarring, existing scleral buckles or glaucoma implants, prior cyclodestructive procedures **Equivalence of baseline characteristics:** Yes, no significant differences in age, race, types of glaucoma, or mean IOP were observed between groups at baseline **Diagnoses in participants:** Glaucoma in participants who were aphakic, pseudophakic, or phakic with a failed filtering procedure
Interventions	**Intervention 1:** 350 mm^2 Baerveldt glaucoma implant **Intervention 2:** 500 mm^2 Baerveldt glaucoma implant **General treatment:** Implant in superotemporal quadrant approximately 10 mm posterior to limbus in most cases; all eyes received scleral patch grafts, postoperative topical atropine sulfate (1%), and subconjunctival injections of 12 mg dexamethasone and 20 mg gentamicin followed by overnight patching; postoperative regimen included topical tobramycin for 2 weeks and prednisolone and atropine for 4 to 6 weeks **Length of follow-up:** Up to 5 years, mean ± SD: 41 ± 19 months in 350 mm^2 Baerveldt group and 38 ± 24 months in 500 mm^2 Baerveldt group
Outcomes	**Primary outcomes:** • Complete success: IOP 6 to 21 mmHg without additional glaucoma surgery and without devastating complications • Qualified success: IOP 6 to 21 mmHg with additional glaucoma surgery and without devastating complications • Qualified failure: IOP > 21 mmHg with medications • Complete failure: Additional glaucoma surgery; hypotony (IOP < 6 mmHg); devastating complications; loss of light perception **Secondary outcomes:** • Mean IOP • Visual acuity • Number of antiglaucoma medications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were analyzed at 1, 2, 3, 4, and 5 years postoperatively
Notes	**Type of study:** Published

Britt 1999 *(Continued)*

Funding: Whittier Foundation, the National Eye Institute, Prevent Blindness Inc., one of the authors (Dr Baerveldt) has a financial interest in the Baerveldt glaucoma implant

Study period: Enrollment between 21 March 1991 and 29 April 1993; data collection ended on 1 September 1997

Reported subgroup analyses: None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"A random-numbers table was used to assign patients to either of the two groups" "The randomization list was generated from a random numbers table"
Allocation concealment (selection bias)	Low risk	"The surgeons made the initial conjunctival incision and confirmed that installation of either plate was technically feasible, randomization assignments then were requested. Operating room personnel read the assignment from the randomization list, to which the surgeons were masked."
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of primary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	Unclear risk	4/107 (4%) total participants, 2 from each group, were excluded from the analysis; unclear how losses to follow-up were handled in the analysis.
Incomplete outcome data (attrition bias) Secondary outcomes	Unclear risk	4/107 (4%) total participants, 2 from each group, were excluded from the analysis; unclear how losses to follow-up were handled in the analysis.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported.
Other bias	Low risk	No other risk of bias identified.

Desai 2013

Methods

Study design: parallel-group, randomized controlled trial

Unit of randomization: individual (1 study eye per person)

Number randomized: 11 total participants; 6 in the Ahmed with intravitreal ranibizumab (IVR) group and 5 in the Ahmed without IVR group

Unit of analysis: individual (1 study eye per person)

Number analyzed: 11 total (6 in the Ahmed with IVR group and 5 in the Ahmed without IVR group)

Losses to follow-up: none reported

Desai 2013 *(Continued)*

	Handling of missing data: n/a, no participants lost to follow-up
Participants	**Country:** USA **Age (years at baseline):** Not reported **Gender:** 2 (33%) men and 4 (66%) women in the Ahmed with IVR group; 2 (40%) men and 3 (60%) women in the Ahmed-alone group **Inclusion criteria:** Age ≥ 21 years; diagnosis of open-angle glaucoma including primary open-angle glaucoma, pseudoexfoliation glaucoma, or pigmentary glaucoma; necessity of receiving drainage implant for purposes of IOP control **Exclusion criteria:** Neovascularization of iris or angle, pregnancy or oral contraceptive intake, corneal scarring precluding adequate visualization of anterior segment structures, previous intravitreal injection of ranibizumab or bevacizumab in either eye, use of clopidogrel or warfarin, uncontrolled hypertension, renal or liver disease **Equivalence of baseline characteristics:** Not assessed in study **Diagnoses in participants:** Not reported
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with intravitreal ranibizumab 0.5 mg/0.05 mL administered at 9 days before surgery, 1 month postoperatively, and 2 months postoperatively **Intervention 2:** Ahmed glaucoma valve without intravitreal ranibizumab **General treatment:** All Ahmed implants performed by 1 surgeon with implant 7 to 8 mm posterior to limbus, quadrant unspecified, use of graft unspecified; all ranibizumab injections in inferotemporal quadrant 3.5 to 4.0 mm from limbus **Length of follow-up:** Up to 6 months
Outcomes	**Primary outcomes:** • Success: IOP < 18 mmHg without necessity for glaucoma medications or IOP < 15 mmHg with ≤ 1 glaucoma medication at 6 months postoperatively • Failure: Need for additional glaucoma surgery **Secondary outcomes:** • Mean IOP • Visual acuity • Number of antiglaucoma medications • Blood pressure • Adverse events • Tube placement **Reported adverse effects:** No, complications were not reported **Other issues with outcome assessment:** Outcomes were analyzed at postoperative days 1 and 7, and postoperative months 1 through 6
Notes	**Type of study:** Published **Funding:** Genentech, Inc. **Study period:** Enrollment period not reported **Reported subgroup analyses:** None reported
Risk of bias	

Desai 2013 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization scheme not described.
Allocation concealment (selection bias)	Unclear risk	Randomization scheme not described.
Masking of outcome assessment (detection bias) Primary outcome	High risk	Study participants not masked to treatment, no sham injections performed in control group.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Study participants not masked to treatment, no sham injections performed in control group.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Not all study participants had full length of follow-up, no mention of intention-to-treat or imputation.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Not all study participants had full length of follow-up, no mention of intention-to-treat or imputation.
Selective reporting (reporting bias)	High risk	No complications reported.
Other bias	Low risk	No other risk of bias identified.

Gerber 1997

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** eye (1 participant had both eyes randomized) **Number randomized:** 30 eyes (29 total participants); 15 in pressure ridge Molteno group and 15 in standard Molteno with suture ligation group **Unit of analysis:** eye (1 participant had both eyes randomized) **Number analyzed:** not explicitly reported **Losses to follow-up:** no 12-week follow-up data for 1 participant in the pressure ridge Molteno group **Handling of missing data:** participants were excluded from analysis from the point at which they underwent additional surgical procedures in the postoperative period
Participants	**Country:** USA **Age (years at baseline):** Mean in pressure ridge Molteno group: 61.5 years (n = 15); mean in standard Molteno with suture ligation group: 64.5 years (n = 15) **Gender:** 5 (33%) men and 10 (67%) women in the pressure ridge Molteno implant group; 6 (40%) men and 9 (60%) women in the standard Molteno implant group **Inclusion criteria:** Not explicitly reported **Exclusion criteria:** History of prior cyclodestructive procedure

Gerber 1997 *(Continued)*

	Equivalence of baseline characteristics: Yes; age, race, gender, and type of glaucoma were similar between the 2 groups at baseline **Diagnoses in participants:** Pseudophakic/aphakic glaucoma, primary open-angle glaucoma, neovascular glaucoma, inflammatory glaucoma, chronic angle-closure glaucoma, glaucoma associated with penetrating keratoplasty, glaucoma associated with ectopia lentis, glaucoma associated with iridocorneal endothelial syndrome
Interventions	**Intervention 1:** Pressure-ridge double-plate Molteno implant without suture ligation **Intervention 2:** Standard double-plate Molteno implant with 9-0 nylon suture ligation **General treatment:** All participants had fornix-based conjunctival flap, donor scleral graft, and standard postoperative steroid and antibiotic regimen; 1% atropine used in all phakic eyes; quadrant of implant not specified **Length of follow-up:** 12 weeks
Outcomes	**Outcomes assessed:** • Mean intraocular pressure • Anterior chamber depth • Visual acuity • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed on postoperative days 1 and 2, and weeks 1, 2, 4, 8, and 12
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Randomization procedure consisted of a nurse selecting a card from a stack at the time of the patient's entry into the operating room"
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analysis from the point at which they underwent additional surgical procedures in the postoperative period.

Gerber 1997 *(Continued)*

Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analysis from the point at which they underwent additional surgical procedures in the postoperative period.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in paper were reported.
Other bias	Unclear risk	1 participant had both eyes randomized; non-independence of eyes was not taken into account.

Gil-Carrasco 2016

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 42 total participants; 21 in Ahmed model M4 group and 21 in Ahmed model S2 group **Unit of analysis:** participant **Number analyzed:** 42 total (21 in Ahmed model M4 group and 21 in Ahmed model S2 group) **Losses to follow-up:** not explicitly reported **Handling of missing data:** not explicitly reported
Participants	**Country:** Mexico **Age (years at baseline):** Mean age not reported **Gender:** 13 (62%) men and 8 (38%) women in the Ahmed model M4 group; 14 (67%) men and 7 (33%) women in the Ahmed model S2 group **Inclusion criteria:** Neovascular glaucoma requiring surgical treatment, age 18 years or older, signed informed consent **Exclusion criteria:** Age younger than 18 years, pregnancy, history of eye surgery or any other conditions that could inhibit IOP measurements with Goldmann tonometer **Equivalence of baseline characteristics:** Yes; age and gender were similar between the 2 groups at baseline **Diagnoses in participants:** Neovascular glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve model M4 (high-density porous polyethylene) **Intervention 2:** Ahmed glaucoma valve model S2 (polypropylene) **General treatment:** All participants had plate anchored 8 mm away from limbus with 7-0 silk in the temporal quadrant, scleral tunnel used to introduce tube into anterior chamber, conjunctiva stitched with 7-0 silk **Length of follow-up:** 1 year
Outcomes	**Outcomes assessed:** • Mean intraocular pressure • Visual acuity • Immediate postoperative complications

Gil-Carrasco 2016 *(Continued)*

	Reported adverse effects: Yes, complications were reported on postoperative day 1 **Other issues with outcome assessment:** Outcomes were assessed on postoperative months 6, 9, and 12
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization process not reported.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcomes not reported.
Incomplete outcome data (attrition bias) Primary outcome	Unclear risk	Number of participants in analysis not reported.
Incomplete outcome data (attrition bias) Secondary outcomes	Unclear risk	Number of participants in analysis not reported.
Selective reporting (reporting bias)	High risk	Not all results for prespecified outcomes were reported.
Other bias	Low risk	No other risk of bias identified.

Heuer 1992

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 132 total participants; 66 in double-plate Molteno group and 66 in single-plate Molteno group **Unit of analysis:** individual (1 study eye per person) **Number analyzed:** 101 total (51 in double-plate Molteno group, 50 in single-plate Molteno group) **Losses to follow-up:** 31 total (15 in double-plate Molteno group, 16 in single-plate Molteno group); excluded after the first stage of installation because their intraocular pressures were adequately con-

Heuer 1992 *(Continued)*

	trolled or their visual potentials were subsequently judged to be inadequate to justify further intraocular surgical procedures; 1 participant in each group with < 6 months follow-up **Handling of missing data:** analysis excluded participants who did not complete the procedure
Participants	**Country:** USA **Age (years at baseline):** Mean ± SD in double-plate Molteno group: 62.1 ± 20.8 (n = 51); mean ± SD in single-plate Molteno group: 61.1 ± 16.2 (n = 50) **Gender:** Not reported **Inclusion criteria:** Medically uncontrollable non-neovascular glaucoma in participants with aphakia or pseudophakia **Exclusion criteria:** Concurrent retinal detachment; first stage of Molteno implantation performed during non-glaucoma surgery in eye with marginally functioning filtering bleb; unable to co-operate for unsedated IOP measurement; prior cyclodestructive procedures; prior Molteno implantation in eye undergoing surgery; prior scleral buckling procedure; recent corneoscleral or corneal wound **Equivalence of baseline characteristics:** Yes; the 2 groups were similar with respect to age, preoperative IOP, and type of glaucoma **Diagnoses in participants:** Open-angle glaucoma, angle-closure glaucoma, uveitic glaucoma, congenital glaucoma, traumatic glaucoma, glaucoma of uncertain etiology
Interventions	**Intervention 1:** Double-plate Molteno implant **Intervention 2:** Single-plate Molteno implant **General treatment:** All participants received scleral graft, quadrant of implant not specified; subconjunctival injections of 12 mg dexamethasone phosphate and 20 mg of gentamicin sulfate were administered separately after most procedures; postoperative regimen in both arms included topical corticosteroids for 2 to 4 months, topical atropine for 4 to 6 weeks, and topical antibiotics for 1 to 4 weeks **Length of follow-up:** 24 months, mean ± SD follow-up was 16.4 ± 6.8 months in the double-plate Molteno group and 14.9 ± 6.9 months in the single-plate Molteno group
Outcomes	**Primary outcomes:** • Success: IOP 6 to 21 mmHg inclusive with no additional glaucoma surgery (other than surgical tube ligature release) and no devastating complications • Complete success: IOP 6 to 21 mmHg with no additional glaucoma procedures or medications • Qualified success: IOP 6 to 21 mmHg with no additional glaucoma procedures with glaucoma medications • Qualified failure: IOP > 21 mmHg with no additional glaucoma procedures • Complete failure: Need for additional glaucoma procedures; loss of light perception attributed to glaucoma; final IOP < 6 mmHg; devastating complications **Secondary outcomes:** • Visual acuity • Number of antiglaucoma medications • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Intervals at which outcomes were assessed were not explicitly reported
Notes	**Type of study:** Published

Heuer 1992 *(Continued)*

Funding: US Department of Health and Human Services; the National Eye Institute; the Foundation for Glaucoma Research; National Glaucoma Research; Research to Prevent Blindness; one of the authors had a financial interest in an aqueous humor shunting device manufactured by another company

Study period: March 1988 to February 1990

Reported subgroup analyses: Participants with at least 6 months of follow-up who were categorized as success and who had undergone surgical ligature release or a 2-stage installation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The randomization lists were generated from a random numbers table, with randomization being stratified for one-stage and two-stage installations"
Allocation concealment (selection bias)	Low risk	Surgeons were masked to allocation lists. The lists, which were kept in large envelopes in a drawer in 1 of the operating rooms, were not accessible to the operating surgeons (personal communication). Treatment assignment was declared by 1 of the operating room personnel after the surgeon confirmed feasibility of the procedure.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors was not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors was not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Not all participants were analyzed since second stage of implant installation was performed in only some participants.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Not all participants were analyzed since second stage of implant installation was performed in only some participants.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in paper were reported.
Other bias	Unclear risk	One of the authors had a financial interest in an aqueous humor shunting device manufactured by another company.

Hwang 2004

Methods

Study design: parallel-group, randomized controlled trial

Unit of randomization: individual (3 participants had both eyes enrolled)

Number randomized: 20 eyes of 17 total participants; 10 eyes of 8 participants in Ahmed implant with surface area expansion group and 10 eyes of 9 participants in Ahmed implant without surface area expansion group

Unit of analysis: eye

Hwang 2004 *(Continued)*

	Number analyzed: 20 eyes of 17 total participants (10 eyes of 8 participants in Ahmed implant with surface area expansion group, 10 eyes of 9 participants in Ahmed implant without surface area expansion group) **Losses to follow-up:** none reported **Handling of missing data:** n/a, no participants lost to follow-up
Participants	**Country:** Korea **Age (years at baseline):** Mean ± SD in Ahmed with surface expansion group: 42.7 ± 23.0 (n = 10); mean ± SD in Ahmed without surface expansion group: 44.3 ± 25.3 (n = 10) **Gender:** 8 eyes of men (80%) and 2 eyes of women (20%) in the Ahmed with surface expansion group; 9 eyes of men (90%) and 1 eye of woman (10%) in Ahmed without surface expansion group **Inclusion criteria:** Glaucoma not responsive to medical, laser, or previous surgical treatment **Exclusion criteria:** None reported **Equivalence of baseline characteristics:** Yes; mean IOP, age, and diagnoses in participants at baseline were similar in both intervention groups **Diagnoses in participants:** Neovascular glaucoma, secondary glaucoma, pseudophakic glaucoma, failed trabeculectomy
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with pericardial membrane surface expansion **Intervention 2:** Ahmed glaucoma valve without pericardial membrane surface expansion **General treatment:** All Ahmed glaucoma valves implanted in superotemporal quadrant, all tubes were partially ligated with 8-0 polygalactin or 10-0 nylon sutures, all participants received subconjunctival gentamicin and dexamethasone after surgery; postoperative treatment in both groups included topical corticosteroids and antibiotics **Length of follow-up:** Planned duration not reported; mean ± SD for Ahmed with surface expansion group: 11.5 ± 5.1 months, for Ahmed without surface expansion group: 14.9 ± 4.3 months
Outcomes	**Primary outcomes:** • Complete success: IOP < 22 mmHg and > 5 mmHg without additional glaucoma surgery, without loss of light perception, and without glaucoma medications • Qualified success: IOP < 22 mmHg and > 5 mmHg without additional glaucoma surgery, without loss of light perception, and with glaucoma medications • Failure: IOP > 21 mmHg on maximally tolerated medications or < 6 mmHg; additional glaucoma surgery including laser treatment; loss of light perception; phthisis bulbi **Secondary outcomes:** • Hypotony defined as IOP < 6 mmHg on 2 consecutive visits • Postoperative hypertensive phase defined as IOP > 21 mmHg in the first 6 postoperative months **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Follow-up intervals were not explicitly reported
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** March 1999 to July 2001

Hwang 2004 *(Continued)*

Reported subgroup analyses: None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of sequence generation not reported; "we performed a prospective, randomized, and controlled trial"
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	High risk	"Neither the physicians nor the patients were masked"
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	"Neither the physicians nor the patients were masked"
Incomplete outcome data (attrition bias) Primary outcome	Low risk	All participants who were randomized were included in the analysis.
Incomplete outcome data (attrition bias) Secondary outcomes	Low risk	All participants who were randomized were included in the analysis.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported.
Other bias	Unclear risk	The unit of randomization was the individual, and the unit of analysis was the eye; the non-independence of eyes was not taken into account.

Kee 2001

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized:** 32 total participants; 16 in Ahmed with partial ligation group and 16 in Ahmed without partial ligation group **Unit of analysis:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 32 total participants; 16 in Ahmed with partial ligation group and 16 in Ahmed without partial ligation group **Losses to follow-up at one year:** none reported **Intention-to-treat analysis:** n/a, no losses to follow-up
Participants	**Country:** Korea **Age (years at baseline):** Mean ± SD in Ahmed with partial ligation group: 55.3 ± 12.6 (n = 16); mean ± SD in Ahmed without ligation group: 58.9 ± 13.1 (n = 16) **Gender:** Not reported

Kee 2001 *(Continued)*

	Inclusion criteria: High IOP or glaucoma not responding to medical treatment, laser surgery, or prior conventional surgery **Exclusion criteria:** None reported **Equivalence of baseline characteristics:** Yes; age and diagnosis in participants were similar in the two groups at baseline **Diagnoses in participants:** Neovascular glaucoma, secondary glaucoma, aphakic glaucoma, previous failed trabeculectomy
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with partial ligation of the tube **Intervention 2:** Ahmed glaucoma valve with no ligation of the tube **General treatment:** All surgeries performed by 1 surgeon, all implants placed in superotemporal quadrant with lyophilized fascia lata, postoperative treatment included topical 0.3% ofloxacin and 1% prednisolone acetate eye drops 4 times a day for 4 weeks **Length of follow-up:** 6 months
Outcomes	**Primary outcomes:** • Complete success: IOP < 22 mmHg and > 5 mmHg without additional glaucoma surgery and without glaucoma medications • Qualified success: IOP < 22 mmHg and > 5 mmHg with glaucoma medications • Failure: IOP > 22 mmHg on maximally tolerated glaucoma medications; need for additional glaucoma surgery **Secondary outcomes:** • Incidence of hypotony, defined as IOP ≤ 5 mmHg on any single visit • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed on postoperative day 1 and "regularly thereafter by one doctor"
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** January 1999 to March 2000 **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization using random permuted blocks within strata
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.

Kee 2001 *(Continued)*

Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	Low risk	All participants who were randomized were included in the analysis.
Incomplete outcome data (attrition bias) Secondary outcomes	Low risk	All participants who were randomized were included in the analysis.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported.
Other bias	Low risk	No other risk of bias identified.

Law 2016

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** eye **Number randomized (total and per group):** 52 eyes of 50 total participants; 26 eyes in low IOP initiation group and 26 eyes in moderate IOP initiation group **Unit of analysis:** eye **Number analyzed (total and per group):** 1 year: 39 eyes total (21 low IOP initiation, 18 moderate IOP initiation); 2 years: 34 eyes total (17 low IOP initiation, 17 moderate IOP initiation) **Losses to follow-up at one year:** 13 total; 3 with medical problems, 5 poor visual potential and refusal to follow up, 1 with complications after surgery, 4 no reason identified **Intention-to-treat analysis:** no, participants lost to follow-up after randomization were not included in the analysis
Participants	**Country:** USA **Age (years at baseline):** Mean ± SD in low IOP initiation group: 67.5 ± 11.6 (n = 26); mean ± SD in moderate IOP initiation group: 61.6 ± 15.3 (n = 26) **Gender:** 13 (50%) men and 13 (50%) women in the low IOP initiation group; 15 (58%) men and 11 (42%) women in the moderate IOP initiation group **Inclusion criteria:** Requiring Ahmed valve implantation to control IOP; between the ages of 18 and 85 years **Exclusion criteria:** Unwilling to accept randomization; known allergic reaction to beta blockers, selective alpha 2 antagonists, carbonic anhydrase inhibitors, or sulfa drugs; medical conditions where beta blocker use is contraindicated; scheduled for concurrent intraocular procedure with Ahmed valve implantation; previous glaucoma drainage device implanted **Equivalence of baseline characteristics:** All demographics and baseline characteristics similar in both groups except for lens status (P = 0.006) **Diagnoses in participants:** Primary open-angle glaucoma, primary angle-closure glaucoma, uveitic glaucoma, neovascular glaucoma, pseudoexfoliation glaucoma, congenital glaucoma, angle-recession glaucoma, secondary open-angle glaucoma, secondary angle-closure glaucoma

Law 2016 *(Continued)*

Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP-7, with postoperative aqueous suppression when IOP > 10 mmHg **Intervention 2:** Ahmed glaucoma valve with postoperative aqueous suppression when IOP > 17 mmHg **General treatment:** All implants placed in superotemporal quadrant and covered with pericardium graft, all participants received antibiotics and steroids 4 times daily after surgery tapered over 4 to 6 weeks **Length of follow-up:** 24 months
Outcomes	**Primary outcomes:** • Mean IOP • Rate of IOP rise • Maximum IOP • Duration of IOP rise **Secondary outcomes:** • Visual acuity • Number of glaucoma medications • Additional glaucoma surgeries • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed weekly for the first postoperative month, then monthly for the first 6 months, and yearly thereafter
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** Not reported **Reported subgroup analyses:** Eyes that developed hypertensive phase, eyes that did not develop hypertensive phase

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Permuted variable block randomization scheme stratified by glaucoma subtype
Allocation concealment (selection bias)	Low risk	Permuted variable block randomization scheme stratified by glaucoma subtype
Masking of outcome assessment (detection bias) Primary outcome	High risk	Neither investigators nor participants were masked to treatment group to which participants were randomized.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Neither investigators nor participants were masked to treatment group to which participants were randomized.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.

Law 2016 *(Continued)*

Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all prespecified outcomes were reported.
Other bias	Unclear risk	2 participants had both eyes enrolled; non-independence was not taken into account.

Mahdy 2013

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 40 total participants; 20 participants in Ahmed with intravitreal bevacizumab (IVB) and panretinal photocoagulation (PRP) group and 20 participants in Ahmed with PRP group **Losses to follow-up:** none reported **Intention-to-treat analysis:** n/a, no loss to follow-up
Participants	**Country:** Egypt **Age (years at baseline):** Mean ± SD in Ahmed with IVB and PRP group: 55 ± 1.3 (n = 20); mean ± SD in Ahmed with PRP group: 56 ± 4.3 (n = 20) **Gender:** 12 (60%) men and 8 (50%) women in the Ahmed with IVB and PRP group; 11 (55%) men and 9 (45%) women in the Ahmed with PRP group **Inclusion criteria:** Neovascular glaucoma and uncontrolled IOP on maximal antiglaucoma medications, evident iris neovascularization, and active retinal pathology without previous PRP available, peripheral anterior synechiae with 360 degrees of angle closure, and small hyphema in the inferior angle on gonioscopy; 18 months of follow-up; under complete control of systemic medications; written informed consent; visual acuity of light perception or better **Exclusion criteria:** Uncontrolled hypertension, renal disease, history of thromboembolic events **Equivalence of baseline characteristics:** Yes; age, gender, preoperative IOP, and predisposing diagnoses were all similar at baseline **Diagnoses in participants:** Neovascular glaucoma secondary to proliferative diabetic retinopathy, central retinal vein occlusion, or ocular ischemic syndrome
Interventions	**Intervention 1:** Ahmed glaucoma valve, S2 polypropylene model, with single injection of IVB and PRP 2 weeks prior to valve implantation **Intervention 2:** Ahmed glaucoma valve with PRP without IVB **General treatment:** All implants placed in superotemporal quadrant with fornix-based conjunctival flap; all IVB injections contained 0.5 mL of 1.25 mg bevacizumab; all PRP had same spot size and pulse duration with variable number of burns and energy; postoperative medication regimen not described in paper **Length of follow-up:** 18 months
Outcomes	**Primary outcomes:**

Mahdy 2013 *(Continued)*

- Complete success: IOP ≤ 21 mmHg and ≥ 10 mmHg without glaucoma medications or surgery, visually devastating complications, or loss of light perception
- Qualified success: IOP ≤ 21 mmHg and ≥ 10 mmHg with glaucoma medications but without glaucoma surgery, visually devastating complications, or loss of light perception
- Failure: Lack of IOP control with or without medications, operative or postoperative devastating conditions, loss of light perception, or need for additional glaucoma surgical intervention

Secondary outcomes:

- Mean IOP
- Visual acuity
- Postoperative complications

Reported adverse effects: Yes, complications were reported

Other issues with outcome assessment: Outcomes were assessed on postoperative days 1, 3, 5, 7, 10, and 15, and months 1, 3, 6, 9, 12, and 18

Notes

Type of study: Published

Funding: Not reported

Study period: Not reported

Reported subgroup analyses: None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization scheme not described.
Allocation concealment (selection bias)	Unclear risk	Randomization scheme not described.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Paper states that trial was "double-blind," but masking procedures were not described in the manuscript.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Paper states that trial was "double-blind," but masking procedures were not described in the manuscript.
Incomplete outcome data (attrition bias) Primary outcome	High risk	No losses to follow-up reported, but participants with less than 18 months of follow-up were excluded from the study.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	No losses to follow-up reported, but participants with less than 18 months of follow-up were excluded from the study.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported.
Other bias	Low risk	No other risk of bias identified.

Nassiri 2010

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 92 total participants; 46 in Ahmed group and 46 in single-plate Molteno group **Number analyzed (total and per group):** 1 year: 69 total (34 Ahmed, 35 Molteno); 2 years: 57 total (29 Ahmed, 28 Molteno) **Losses to follow-up at one year:** 22 total; 11 Ahmed group and 11 Molteno; surgical failure was excluded from subsequent follow-up (1 participant in the Ahmed group failed at 1 year) **Intention-to-treat analysis:** no, participants lost to follow-up were excluded from analysis
Participants	**Country:** Iran **Age (years at baseline):** Mean ± SD in Ahmed group: 59.4 ± 10.2 (n = 46); mean ± SD in Molteno group: 63.3 ± 11.0 (n = 46) **Gender:** 25 (54%) men and 21 (46%) women in the Ahmed group; 22 (48%) men and 24 (52%) women in the Molteno group **Inclusion criteria:** Refractory glaucoma, defined as uncontrolled IOP despite maximal antiglaucoma medication, previously failed non-seton surgical treatment, or a combination thereof **Exclusion criteria:** Age younger than 40 years, no light perception, lens opacity, elevated IOP associated with silicone oil, previous glaucoma drainage device implantation in the same eye, previous cyclodestructive treatment, increased risk of endophthalmitis (e.g. active adnexal and ocular surface infection, immunosuppression, or immunodeficiency, including the use of systemic steroids), posterior segment disorders, or pre-existing ocular comorbidities (e.g. pterygium, phacodonesis, corneal opacity, or corneal endothelial dystrophies) **Equivalence of baseline characteristics:** Yes; demographics, background conditions, previous glaucoma treatments, lens status, glaucoma subtype, IOP, visual acuity, and number of glaucoma medications all similar at baseline **Diagnoses in participants:** Failed filtration, pseudophakic glaucoma, neovascular glaucoma, aphakic glaucoma, uveitic glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP-7 **Intervention 2:** Single-plate Molteno implant **General treatment:** Both implants placed superotemporally with fornix-based conjunctival flap, Molteno implant was occluded with 7.0 polyglactin 910 (Vicryl) suture, tube was covered with scleral patch graft; all participants received subconjunctival antibiotics and corticosteroids after surgery; postoperative management consisted of topical antibiotics and steroids tapered over 6 to 8 weeks **Length of follow-up:** 24 months
Outcomes	**Primary outcomes:** • Complete success: IOP 6 to 21 mmHg without glaucoma medications • Qualified success: IOP 6 to 21 mmHg with 1 or more glaucoma medications • Failure: Persistent IOP > 21 mmHg on maximally tolerated medications or IOP < 6 mmHg on 2 consecutive visits, phthisis bulbi, loss of light perception, removal of implant, reoperation for glaucoma, devastating intraoperative or postoperative complications **Secondary outcomes:** • Mean IOP • Number of glaucoma medications

Nassiri 2010 *(Continued)*

- Visual acuity
- Humphrey visual fields

Reported adverse effects: Yes, complications were reported

Other issues with outcome assessment: Outcomes were assessed at day 1, week 1, and months 1, 3, 6, 9, 12, 18, and 24

Notes

Type of study: Published

Funding: None reported

Study period: January 2003 through August 2005

Reported subgroup analyses: None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomization was performed using a random permuted block design with a block size of 2, stratified for age, sex, and hosting medical center"
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described.
Masking of outcome assessment (detection bias) Primary outcome	High risk	"Neither patients nor investigators were masked to study groups"
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	"Neither patients nor investigators were masked to study groups"
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants lost to follow-up were excluded from analyses at 1 year and 2 years; no imputation methods were used.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants lost to follow-up were excluded from analyses at 1 year and 2 years; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported.
Other bias	Low risk	No other risk of bias identified.

Pakravan 2007

Methods

Study design: parallel-group, randomized controlled trial

Unit of randomization: individual (1 study eye per person)

Unit of analysis: eye

Number randomized (total and per group) and analyzed: 30 eyes of 28 total participants; 15 eyes of 15 participants in Ahmed with MMC group and 15 eyes of 13 participants in trabeculectomy with MMC group

Pakravan 2007 *(Continued)*

	Unit of analysis: eye **Losses to follow-up at one year:** none reported **Intention-to-treat analysis:** n/a, no losses to follow-up
Participants	**Country:** Iran **Age (years at baseline):** Mean ± SD in Ahmed with MMC group: 10.9 ± 5.1 (n = 15); mean ± SD in trabeculectomy with MMC group: 9.1 ± 4.1 (n = 13) **Gender:** 12 (80%) men and 3 (20%) women in the Ahmed with MMC group; 6 (46%) men and 7 (54%) women in the trabeculectomy with MMC group **Inclusion criteria:** Younger than 16 years of age; previous anterior lensectomy and vitrectomy for congenital cataract with aphakic glaucoma unresponsive to at least 2 medications **Exclusion criteria:** History of ocular surgery other than anterior lensectomy/vitrectomy; congenital cataract in the setting of persistent fetal vasculature or intrauterine infections; follow-up less than 6 months (except for failed cases) **Equivalence of baseline characteristics:** Not statistically assessed **Diagnoses in participants:** Pediatric aphakic glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with MMC **Intervention 2:** Trabeculectomy with MMC **General treatment:** MMC 0.2% used in both groups, all participants received subconjunctival gentamicin and betamethasone at the end of surgery; topical antibiotics administered 4 times a day for 1 week postoperatively, topical steroids tapered over 1 to 2 months, cycloplegic use limited to cases with severe inflammation or shallow/flat anterior chamber **Length of follow-up:** Planned: 36 months; actual: 6 to 36 months
Outcomes	**Primary outcomes:** • Complete success: IOP > 5 mmHg and ≤ 21 mmHg without glaucoma medications • Qualified success: IOP > 5 mmHg and ≤ 21 mmHg with no more than 2 glaucoma medications • Failure: Not meeting criteria for complete or qualified success, further surgery needed, occurrence of vision-threatening complication, cup-to-disc ratio increased more than 0.2 on examination, loss of more than 2 lines of Snellen visual acuity **Secondary outcomes:** • Visual acuity • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at 1, 2, 3, 7, 14, 30, 60, and 90 days after the operation and every 3 months thereafter
Notes	**Type of study:** Published **Funding:** Not reported, the authors reported having no financial interest in the subject of this study **Study period:** 2003 to 2005 **Reported subgroup analyses:** Participants with successful control of IOP
Risk of bias	

Pakravan 2007 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method of sequence generation not reported; "subjects ... were randomly allocated in 2 groups"
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported, although "data were analyzed by a statistician unaware of the groups"
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported, although "data were analyzed by a statistician unaware of the groups"
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants with less than 6 months of follow-up were excluded from the study; "exclusion criteria were ... follow-up of less than 6 months (except for failed cases)"
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants with less than 6 months of follow-up were excluded from the study; "exclusion criteria were ... follow-up of less than 6 months (except for failed cases)"
Selective reporting (reporting bias)	Low risk	Results for all prespecified outcomes were reported.
Other bias	Unclear risk	The unit of randomization was the individual, and the unit of analysis was the eye; the non-independence of eyes was not taken into account.

Pakravan 2014

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 94 total participants; 47 in early aqueous suppression group, 47 in standard aqueous suppression group **Number analyzed (total and per group):** 94 total; 47 in Ahmed with early aqueous suppression group, 47 in Ahmed with standard aqueous suppression group; participants were excluded from analysis after loss to follow-up **Losses to follow-up:** not reported, but percentages in analyses reflect gradual decrease of denominator over time in both groups, indicating likely loss to follow-up **Intention-to-treat analysis:** no, participants lost to follow-up after randomization were not included in the analysis
Participants	**Country:** Iran **Age (years at baseline):** Mean ± SD in early aqueous suppression group: 47 ± 18 (n = 47); mean ± SD in standard aqueous suppression group: 41 ± 19 (n = 47) **Gender:** Not reported **Inclusion criteria:** Glaucoma requiring Ahmed valve implantation

Pakravan 2014 *(Continued)*

	Exclusion criteria: Age younger than 18 years; mental illness or dementia; history of glaucoma implants; known allergies to glaucoma medications; known contraindications to use of beta blockers; eyes with less than 3 months of follow-up **Equivalence of baseline characteristics:** Yes; age, cup-to-disc ratio, IOP, number of glaucoma medications, history of intraocular surgery, and glaucoma subtype were all similar at baseline **Diagnoses in participants:** Combined mechanism glaucoma, aphakic glaucoma, neovascular glaucoma, pseudophakic glaucoma, developmental glaucoma, primary congenital glaucoma, inflammatory glaucoma, primary angle-closure glaucoma, post-traumatic glaucoma, juvenile open-angle glaucoma, primary open-angle glaucoma, pseudoexfoliation glaucoma, steroid-induced glaucoma, ghost cell glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model unspecified, with aqueous suppression when IOP > 10 mmHg **Intervention 2:** Ahmed glaucoma valve with aqueous suppression when IOP > target pressure **General treatment:** All implants placed in superotemporal quadrant with scleral patch graft and subconjunctival betamethasone and cefazolin at end of surgery; postoperative topical antibiotics for 1 week and steroids tapered over 8 to 12 weeks; early aqueous suppression group received combination dorzolamide/timolol, standard aqueous suppression group received stepwise regimen of timolol followed by dorzolamide, brimonidine, and latanoprost **Length of follow-up:** Planned duration not specified; mean ± SD weeks of follow-up was 45 ± 11.6 in early aqueous suppression group and 47.2 ± 7.4 in standard aqueous suppression group
Outcomes	**Primary outcomes:** • Complete success: IOP > 6 mmHg and < 15 mmHg and reduction 30% or more from baseline without glaucoma medications • Qualified success: IOP > 6 mmHg and < 15 mmHg and reduction 30% or more from baseline with maximally tolerated glaucoma medications **Secondary outcomes:** • Frequency of hypertensive phase • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed postoperative day 1, weeks 1, 2, 3, 4, 6, 8, 12, 16, 24, and 54 and every 6 months thereafter
Notes	**Type of study:** Published **Funding:** Ophthalmic Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran **Study period:** December 2010 to October 2012 **Reported subgroup analyses:** Success rates at different time points in participants with complete success, qualified success, and overall success

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization scheme not reported.
Allocation concealment (selection bias)	Unclear risk	Randomization scheme not reported.

Pakravan 2014 *(Continued)*

Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking scheme not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking scheme not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants lost to follow-up prior to 3 months were excluded from the trial.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants lost to follow-up prior to 3 months were excluded from the trial.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported.
Other bias	Low risk	No other risk of bias identified.

Parihar 2016

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 58 total participants; 47 in pars plana Ahmed group, 47 in conventional Ahmed group **Number analyzed (total and per group):** 94 total; 29 in pars plana Ahmed group, 29 in conventional Ahmed group; participants were excluded from analysis after loss to follow-up **Losses to follow-up:** 8 total, 4 in each group **Intention-to-treat analysis:** no, participants lost to follow-up after randomization were not included in the analysis
Participants	**Country:** India **Age (years at baseline):** Mean ± SD in pars plana Ahmed group: 62.6 ± 14.2 (n = 25); mean ± SD in conventional Ahmed group: 64.6 ± 12.8 (n = 25) **Gender:** 16 (64%) men and 9 (36%) women in the pars plana Ahmed group; 15 (60%) men and 10 (40%) women in the conventional Ahmed group **Inclusion criteria:** Age 18 years or older, corneal disease requiring penetrating keratoplasty, IOP > 21 mmHg on 3 or more glaucoma medications **Exclusion criteria:** Age younger than 18 years, retinal disease, neovascular glaucoma, optic nerve disease **Equivalence of baseline characteristics:** Yes; age, gender, IOP, and number of glaucoma medications were all similar at baseline **Diagnoses in participants:** Open-angle glaucoma, angle-closure glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model PC7, with pars plana insertion

Parihar 2016 *(Continued)*

	Intervention 2: Ahmed glaucoma valve, model FP7, with anterior chamber insertion **General treatment:** All except 3 cases under peribulbar anesthesia, all valves placed in superotemporal quadrant, plate anchored 7 mm from limbus, tube tied with 6-0 polyglactin 910 (Vicryl) to prevent postoperative hypotony, lens extraction on all phakic participants **Length of follow-up:** 2 years
Outcomes	**Primary outcomes:** • Complete success: IOP ≤ 21 mmHg or ≥ 5 mmHg without antiglaucoma medications • Qualified success: IOP ≤ 21 mmHg or ≥ 5 mmHg with antiglaucoma medications or minor procedures such as anterior chamber reformation, anterior vitrectomy, tube repositioning **Secondary outcomes:** • Graft success • Visual acuity • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at year 2
Notes	**Type of study:** Published **Funding:** Armed Forces Medical Services **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Odd-even randomization using computer-generated random numbers
Allocation concealment (selection bias)	High risk	Allocation of participants to treatment and surgical groups was done by single person.
Masking of outcome assessment (detection bias) Primary outcome	High risk	"Blinding was not performed"
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	"Blinding was not performed"
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants lost to follow-up before end of study were excluded from analyses.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants lost to follow-up before end of study were excluded from analyses.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported.

Parihar 2016 *(Continued)*

Other bias	Low risk	No other risk of bias identified.

Rho 2015

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** not specified **Unit of analysis:** eye **Number randomized (total and per group):** not specified **Number analyzed (total and per group):** 43 eyes of 40 participants; 22 eyes in Ahmed with collagen matrix group, 21 eyes in Ahmed alone group **Intention-to-treat analysis:** not specified
Participants	**Country:** Korea **Age (years at baseline):** Mean ± SD in Ahmed with collagen matrix group: 62.73 ± 13.87 (n = 22); mean ± SD in conventional Ahmed group: 61.52 ± 14.30 (n = 21) **Gender:** 14 (64%) men and 8 (36%) women in the Ahmed with collagen matrix group; 19 (90%) men and 2 (10%) women in the Ahmed-alone group **Inclusion criteria:** Refractory glaucoma with IOP > 20 mmHg despite maximal medical treatment **Exclusion criteria:** Age younger than 18 years, previous history of glaucoma surgery, postoperative complications such as endophthalmitis or tube obstruction **Equivalence of baseline characteristics:** No, the collagen matrix group had a lower percentage of men **Diagnoses in participants:** Refractory glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve with biodegradable collagen matrix **Intervention 2:** Ahmed glaucoma valve without biodegradable collagen matrix **General treatment:** All valves placed in superotemporal quadrant, tube was tied twice with 8-0 polyglactin 910 (Vicryl) suture, tube was primed with balanced salt solution, conjunctiva was reapproximated with 8-0 polyglactin 910 (Vicryl) suture **Length of follow-up:** 6 months
Outcomes	**Primary outcomes:** • Complete success definition 1: IOP ≤ 21 mmHg or ≥ 5 mmHg without antiglaucoma medications • Complete success definition 2: IOP ≤ 17 mmHg or ≥ 5 mmHg without antiglaucoma medications • Qualified success: IOP ≤ 21 mmHg or ≥ 5 mmHg with antiglaucoma medication **Secondary outcomes:** • Number of glaucoma medications • Hypertensive phase: IOP increase to 21 mmHg or greater during 2 consecutive visits 2 weeks apart 1 to 3 months after surgery • Postoperative complications **Reported adverse effects:** Yes, complications were reported

Rho 2015 *(Continued)*

	Other issues with outcome assessment: Outcomes were assessed on days 1 and 3, and weeks 1, 2, 3, 4, 6, 8, 12, 16, 20, and 24
Notes	**Type of study:** Published **Funding:** None reported **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomization according to the table of random sampling numbers"
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessment not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessment not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Original number randomized not reported in study.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Original number randomized not reported in study.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported.
Other bias	High risk	Inclusion criteria specify that participants with postoperative complications were excluded from study.

Rojo-Arnao 2011

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 13 total participants; 7 in Ahmed with subconjunctival bevacizumab (SCB) group and 6 in Ahmed without SCB group **Losses to follow-up:** none reported **Intention-to-treat analysis:** n/a, no losses to follow-up
Participants	**Country:** Mexico

Rojo-Arnao 2011 *(Continued)*

	Age (years at baseline): Mean ± SD in Ahmed with SCB group: 61.9 ± 14.4 (n = 7); mean ± SD in Ahmed without SCB group: 56.8 ± 13.6 (n = 6) **Gender:** 2 (29%) men and 5 (71%) women in the Ahmed with SCB group; 3 (50%) men and 3 (50%) women in the Ahmed without SCB group **Inclusion criteria:** Ahmed valve surgery was deemed necessary secondary to advancing glaucoma despite maximal medical or laser therapy, as evidenced by changes in optic nerve or visual field defects **Exclusion criteria:** Functioning filtering surgery; uveitis; scleral thinning; retinal neovascular proliferations with traction that could induce retinal detachment; complications during implant surgery; previous myocardial infarction or serious cardiovascular event; pregnancy or lactating females; non-compliance with control visits; declining participation **Equivalence of baseline characteristics:** Yes; age, gender, IOP, number of glaucoma medications, operated eye, glaucoma subtype, and surgeon level were all similar at baseline **Diagnoses in participants:** Neovascular glaucoma, chronic angle-closure glaucoma, primary open-angle glaucoma, pseudophakic glaucoma, pigmentary glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model S2, with SCB on postoperative days 1 and 7 **Intervention 2:** Ahmed glaucoma valve without SCB **General treatment:** All implants placed in superotemporal quadrant with fornix-based conjunctival flap; postoperative antibiotics for 2 weeks, steroids tapered over 3 months, and cycloplegic for 1 month; 0.1 mL of 2.5 mg bevacizumab applied subconjunctivally next to valve plate for all participants in treatment group **Length of follow-up:** 3 months
Outcomes	**Primary outcome:** • Mean IOP level with or without ocular massage **Secondary outcomes:** • Bleb cross-sectional area at the highest point **Reported adverse effects:** No, complications were not reported **Other issues with outcome assessment:** Outcomes were assessed on postoperative days 1, 7, 15, 30, 45, and 90
Notes	**Type of study:** Published **Funding:** None reported **Study period:** September to November 2009 **Reported subgroup analyses:** None

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator software used to randomize participants.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.

Rojo-Arnao 2011 *(Continued)*

Masking of outcome assessment (detection bias) Primary outcome	High risk	Masking by injected balanced salt solution in control eyes was abandoned because participants in treatment group experienced burning sensation with injection while participants in control group did not.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Masking by injected balanced salt solution in control eyes was abandoned because participants in treatment group experienced burning sensation with injection while participants in control group did not.
Incomplete outcome data (attrition bias) Primary outcome	Low risk	No losses to follow-up reported.
Incomplete outcome data (attrition bias) Secondary outcomes	Low risk	No losses to follow-up reported.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported in analysis.
Other bias	High risk	Complications not reported.

Smith 1992

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** eye **Unit of analysis:** eye **Number randomized (total and per group):** 46 eyes of 40 total participants; 22 in double-plate Molteno group and 24 in Schocket shunt group; 6 participants who required bilateral surgery were randomized for the first eye, and the other eye received the alternate treatment **Unit of analysis:** individual **Number analyzed (total and per group):** 40 eyes of 40 participants total; 19 eyes of 19 participants in double-plate Molteno group and 21 eyes of 20 participants in Schocket shunt group; for the 6 participants with 2 eyes enrolled, 3 participants were assigned to each group using a random digit table, and the other eye was not included in analyses **Losses to follow-up:** 2 participants with phthisis bulbi total (1 per group) were excluded from analyses at 1 year **Intention-to-treat analysis:** no, participants with phthisis were excluded from 1-year analysis
Participants	**Country:** USA **Age (years at baseline):** Not reported **Gender:** 3 (16%) men and 16 (84%) women in the Molteno group; 8 (38%) men and 13 (62%) women in the Schocket shunt group **Inclusion criteria:** Eyes with glaucoma requiring surgery irrespective of type of glaucoma except the congenital variety **Exclusion criteria:** Children with congenital glaucoma; people undergoing simultaneous penetrating keratoplasty and drainage tube procedure

Smith 1992 *(Continued)*

	Equivalence of baseline characteristics: Yes; mean IOP, glaucoma medications, and types of glaucoma similar at baseline **Diagnoses in participants:** Aphakic/pseudophakic glaucoma; prior unsuccessful glaucoma filtration surgery; uveitic glaucoma; neovascular glaucoma; glaucoma following penetrating keratoplasty; glaucoma associated with congenital rubella syndrome (aphakic)
Interventions	**Intervention 1:** Double-plate Molteno implant **Intervention 2:** Anterior chamber tube shunt to an encircling band or Schocket shunt **General treatment:** All tubes covered with scleral patch graft, no antifibrotics were administered; all participants received topical prednisolone and tobramycin in the early postoperative period **Length of follow-up:** Planned: every 3 to 6 months after 6 months following surgery; actual: 6 to 49 months
Outcomes	**Outcomes:** • IOP control reported as final mean IOP • Mean change in IOP • Number of postoperative medications • Decrease in visual acuity • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative days 1 and 2, weeks 1, 2, and 3, months 1, 3, and 6, and every 3 to 6 months thereafter
Notes	**Type of study:** Published **Funding:** Research to Prevent Blindness, Inc.; the National Eye Institute **Study period:** 1987 to 1989 **Reported subgroup analyses:** 6 participants with bilateral surgery

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization scheme not reported.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking scheme not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking scheme not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	2 participants were excluded from analyses at 1-year follow-up.

Smith 1992 *(Continued)*

Incomplete outcome data (attrition bias) Secondary outcomes	High risk	2 participants were excluded from analyses at 1-year follow-up.
Selective reporting (reporting bias)	Low risk	Results for all outcomes specified in the paper were reported.
Other bias	Unclear risk	6 participants with surgery in both eyes had 1 eye randomized to 1 treatment and the other treatment in the other eye; 1 eye from each participant was then assigned to 1 group for analysis, and the other eye was excluded from the study.

Teixeira 2012

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 49 total participants; 22 in Ahmed with intravitreal triamcinolone (IVTA) group and 27 in Ahmed without IVTA group **Losses to follow-up at one year:** 6 total; 4 in Ahmed with IVTA group (1 died, 3 lost to follow-up), 2 in Ahmed without IVTA group (1 died, 1 lost to follow-up) **Intention-to-treat analysis:** no, participants lost to follow-up after randomization were not included in the analysis
Participants	**Country:** Brazil **Age (years at baseline):** Mean ± SD in Ahmed with IVTA group: 62.91 ± 7.26 (n = 22); mean ± SD in Ahmed without IVTA group: 57.48 ± 15.32 (n = 27) **Gender:** 16 (73%) men and 6 (27%) women in the Ahmed with IVTA group; 15 (56%) men and 12 (44%) women in the Ahmed without IVTA group **Inclusion criteria:** Older than 17 years with uncontrolled neovascular glaucoma from any etiology except intraocular tumors or uveitis; uncontrolled defined as IOP > 22 mmHg on maximally tolerated medications **Exclusion criteria:** No light perception; neovascular glaucoma secondary to intraocular tumor or uveitis; unwilling or unable to return for follow-up; pregnancy; earlier cyclodestructive procedure, scleral buckle, or silicone oil surgery **Equivalence of baseline characteristics:** Yes; age, gender, race, etiology of neovascular glaucoma, and comorbidities were similar in both groups **Diagnoses in participants:** Neovascular glaucoma from diabetic retinopathy or central retinal vein occlusion
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP7, with intraoperative IVTA **Intervention 2:** Ahmed glaucoma valve without IVTA **General treatment:** Implants were placed preferably in superotemporal quadrant, all implants covered with scleral patch graft, subconjunctival gentamicin and dexamethasone given at end of procedure; all participants received atropine drops and a patch after surgery; 0.1 mL of IVTA was given via pars plana 3.0 to 3.5 mm posterior to limbus with 27-gauge needle to treatment group **Length of follow-up:** 1 year

Teixeira 2012 *(Continued)*

Outcomes	**Primary outcomes:** • Complete success: absence of IOP > 21 mmHg or < 6 mmHg on 2 consecutive measurements; no loss of light perception, glaucoma surgery, serious complications, or use of 2+ medications to achieve target IOP • Success: absence of IOP > 21 mmHg or < 6 mmHg on 2 consecutive measurements; no loss of light perception, glaucoma surgery, or serious complications **Secondary outcomes:** • Mean IOP • Visual acuity • Number of glaucoma medications • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed postoperative day 1, week 1, months 1, 3, 6, and 9, and year 1
Notes	**Type of study:** Published **Funding:** National Council of Technological and Scientific Development (CNPQ), Brazil **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomized using computer-generated randomization table.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	High risk	Staff and statistician were masked to treatment group, but surgeon who performed IVTA injection was responsible for participant follow-up.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Staff and statistician were masked to treatment group, but surgeon who performed IVTA injection was responsible for participant follow-up.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants lost to follow-up after 90 days were excluded from subsequent analysis.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants lost to follow-up after 90 days were excluded from subsequent analysis.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported in analysis.
Other bias	Low risk	No other risk of bias identified.

TVT 2009

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 212 total participants; 107 in Baerveldt group and 105 in trabeculectomy group **Number analyzed (total and per group):** 1 year: 189 total (97 Baerveldt, 92 trabeculectomy); 3 years: 158 total (80 Baerveldt, 78 trabeculectomy); 5 years: 145 total (69 Baerveldt, 76 trabeculectomy) **Losses to follow-up:** 1 year: 23 total, 10 Baerveldt (2 died, 8 lost to follow-up), 13 trabeculectomy (2 died, 11 lost to follow-up); 3 years: 54 total, 27 Baerveldt (5 died, 22 lost to follow-up), 27 trabeculectomy (11 died, 16 lost to follow-up); 5 years: 67 total, 38 Baerveldt (14 died, 24 lost to follow-up), 29 trabeculectomy (14 died, 15 lost to follow-up) **Intention-to-treat analysis:** no; participants who missed follow-up visits were not included in the analysis
Participants	**Country:** USA, UK **Age (years at baseline):** Mean ± SD in Baerveldt group: 70.9 ± 11.0 (n = 107); mean ± SD in trabeculectomy group: 71.1 ± 9.9 (n = 105) **Gender:** 43 (40%) men and 64 (60%) women in the Baerveldt group; 57 (54%) men and 48 (46%) women in the trabeculectomy group **Inclusion criteria:** Age 18 to 85 years; inadequately controlled glaucoma with IOP > 18 mmHg and < 40 mmHg on maximum tolerated medical therapy; previous cataract extraction with intraocular lens implantation, trabeculectomy, or both **Exclusion criteria:** Unwilling or unable to give consent, unwilling to accept randomization, or unable to return for scheduled protocol visits; pregnant or nursing women; no light perception vision; active iris neovascularization or active proliferative retinopathy; iridocorneal endothelial syndrome; epithelial of fibrous downgrowth; aphakia; vitreous in the anterior chamber for which a vitrectomy is anticipated; chronic or recurrent uveitis; severe posterior blepharitis; unwilling to discontinue contact lens use after surgery; previous cyclodestructive procedure, scleral buckling procedure, or silicone oil present; conjunctival scarring precluding a trabeculectomy superiorly; need for glaucoma surgery combined with other ocular procedures (i.e. cataract surgery, penetrating keratoplasty, or retinal surgery) or anticipated need for additional ocular surgery **Equivalence of baseline characteristics:** Yes; demographics, study eye, IOP, number of glaucoma medications, previous laser therapy, previous intraocular surgery, glaucoma subtype, lens status, visual acuity, reason for decreased vision, Humphrey visual fields, visual function quality score, and diplopia were similar between 2 groups at baseline **Diagnoses in participants:** Primary open-angle glaucoma, chronic angle-closure glaucoma, pseudoexfoliative glaucoma, pigmentary glaucoma
Interventions	**Intervention 1:** 350 mm^2 Baerveldt glaucoma implant **Intervention 2:** Trabeculectomy with MMC **General treatment:** Baerveldt implant was placed in superotemporal quadrant for all participants with limbal- or fornix-based conjunctival flap, method of temporary tube occlusion left to discretion of surgeon, tube was covered with scleral, dura mater, or pericardium patch graft; scleral flap for trabeculectomy was limbal- or fornix-based by surgeon discretion, 0.4 mg/mL of MMC was administered for 4 minutes; postoperative medication regimens for both groups were by surgeon discretion **Length of follow-up:** 5 years
Outcomes	**Primary outcomes:**

TVT 2009 *(Continued)*

- Mean IOP
- Failure: IOP > 21 mmHg or not reduced by 20% below baseline on 2 consecutive follow-up visits after 3 months; IOP ≤ 5 mmHg on 2 consecutive follow-up visits after 3 months; additional glaucoma surgery; loss of light perception
- Complete success: eyes that have not failed and are not on supplemental medical therapy
- Qualified success: eyes that have not failed but require supplemental medical therapy

Secondary outcomes:

- Visual acuity
- Reoperation for glaucoma
- Number of glaucoma medications
- Postoperative complications
- Visual fields
- Quality of life

Reported adverse effects: Yes, complications were reported

Other issues with outcome assessment: Outcomes were assessed at day 1, week 1, months 1, 3, 6, 12, 18, and 24, and years 3, 4, and 5; study outcomes were monitored by an independent Safety and Data Monitoring Committee

Notes

Type of study: Published

Funding: Funded by Pfizer, Inc. and Abbott Medical Optics, Inc. (manufacturers of Baerveldt implant), National Eye Institute, and Research to Prevent Blindness, Inc.

Study period: October 1999 to April 2004

Reported subgroup analyses: Participants with previous glaucoma or cataract surgery

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization was performed using a variable permuted block design stratified by clinical center and type of previous intraocular surgery.
Allocation concealment (selection bias)	Low risk	Randomization was performed using a variable permuted block design stratified by clinical center and type of previous intraocular surgery.
Masking of outcome assessment (detection bias) Primary outcome	High risk	Neither the participant nor the clinician was masked to the randomization assignment during follow-up.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Neither the participant nor the clinician was masked to the randomization assignment during follow-up.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	High risk	Not all prespecified outcomes were reported in final analyses.

TVT 2009 *(Continued)*

Other bias	High risk	Funded by Pfizer, Inc. and Abbott Medical Optics, Inc. (manufacturers of Baerveldt implant); several study investigators have financial interests in the Baerveldt implant.

Valimaki 1999

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 22 total participants; 11 in Molteno with oral corticosteroids group and 11 in Molteno without oral corticosteroids group **Number analyzed (total and per group):** 21 total; 10 in Molteno with oral corticosteroids group and 11 in Molteno without oral corticosteroids group **Losses to follow-up:** 1 participant in Molteno with oral corticosteroids group was withdrawn from the study due to gastric irritation from oral prednisone **Intention-to-treat analysis:** no, participant lost to follow-up was excluded from the analysis
Participants	**Country:** Finland **Age (years at baseline):** Mean ± SD in Molteno with oral corticosteroids group: 60 ± 16 (n = 10); mean ± SD in Molteno without oral corticosteroids group: 74 ± 9 (n = 11) **Gender:** 7 (70%) men and 3 (30%) women in the Molteno with oral corticosteroids group; 4 (36%) men and 7 (64%) women in the Molteno without oral corticosteroids group **Inclusion criteria:** Older than 25 years of age; no history of any type of corticosteroid treatment within 2 weeks of surgery; high risk of filtration failure (failed conventional glaucoma surgery, neovascular, traumatic, uveitic glaucoma); visual function likely to fail at current level IOP on maximally tolerated medical and laser treatment **Exclusion criteria:** Diabetes mellitus; congestive heart failure; gastric or duodenal ulcer disease; history of psychiatric disease or active infection; regular use of non-steroidal anti-inflammatory drugs; pregnant or nursing women; women on inadequate contraception; people who had undergone argon laser trabeculoplasty or any type of ocular surgery within 6 months prior to enrollment **Equivalence of baseline characteristics:** No; age of participants statistically differed in the 2 treatment groups **Diagnoses in participants:** Primary open-angle glaucoma, exfoliative glaucoma, neovascular glaucoma, uveitic glaucoma, traumatic and juvenile glaucoma
Interventions	**Intervention 1:** Single-plate, single-stage Molteno implant with oral prednisone started on postoperative day 14 at 60 mg and tapered over 10 weeks **Intervention 2:** Single-plate, single-stage Molteno implant without oral corticosteroids **General treatment:** All implants placed in inferotemporal quadrant with fornix-based conjunctival flap, no patch grafts or antimetabolites used with implant placement; both groups received topical antibiotics for 2 weeks and topical steroids for 12 weeks following surgery **Length of follow-up:** 6 months
Outcomes	**Primary outcomes:** • Success: IOP 6 to 22 mmHg inclusive with fewer than or as many antiglaucoma medications as at the preoperative visit

Valimaki 1999 *(Continued)*

- Failure: loss of light perception, repeat surgery for uncontrolled IOP

Secondary outcomes:

- Visual acuity
- Number of glaucoma medications
- Presence of filtration
- Systemic side effects from oral prednisone
- Serum marker studies for collagen synthesis
- Postoperative complications

Reported adverse effects: Yes, complications were reported

Other issues with outcome assessment: Outcomes were assessed at postoperative day 1 and weeks 2, 4, 6, 8, 10, 12, and 24

Notes

Type of study: Published

Funding: The Silmäsäätiö Foundation, the Väinö and Hilkka Kiltti Foundation, the Finnish Medical Foundation, and the OYS KEVO

Study period: August 1995 to February 1997

Reported subgroup analyses: None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Sequence generation not reported.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	1 participant withdrew from study and was excluded from all analyses.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	1 participant withdrew from study and was excluded from all analyses.
Selective reporting (reporting bias)	Low risk	Results for all prespecified outcomes were reported in the analysis.
Other bias	Low risk	No other risk of bias identified.

Wilson 1992

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 134 total participants; number randomized to each group was not reported **Number analyzed (total and per group):** 118 total; 65 in Molteno group and 53 in Schocket shunt group **Losses to follow-up:** 6 participants were lost to follow-up at 6 months **Intention-to-treat analysis:** no; data from 16 randomized participants were excluded from study (6 lost to follow-up, 9 who had not yet completed 6 months of follow-up, 1 withdrawn after development of sympathetic ophthalmia)
Participants	**Country:** USA **Age (years at baseline):** Mean in Molteno group: 58.2 (n = 65); mean in Schocket shunt group: 59.1 (n = 53); no standard deviations reported **Gender:** 29 (45%) men and 36 (55%) women in Molteno group; 23 (44%) men and 30 (56%) women in Schocket shunt group **Inclusion criteria:** Uncontrolled IOP; prior unsuccessful filtration surgery with an antifibrosis regimen diagnosis that would be expected to have poor response to filtration surgery; private patient status **Exclusion criteria:** None reported **Equivalence of baseline characteristics:** Yes; age, gender, glaucoma subtype, and IOP similar at baseline between groups **Diagnoses in participants:** Aniridia, chronic angle-closure glaucoma with aphakia, chronic open-angle glaucoma with aphakia, combined mechanism glaucoma, congenital glaucoma, inflammatory glaucoma, iridocorneal endothelial syndrome, neovascular glaucoma, primary angle-closure glaucoma, primary open-angle glaucoma, pseudoexfoliation glaucoma, traumatic glaucoma
Interventions	**Intervention 1:** Double-plate Molteno implant **Intervention 2:** Schocket shunt **General treatment:** Surgical technique "was standardized as much as clinical conditions permitted," no postoperative medication regimen described **Length of follow-up:** Planned: 12 months; actual: 6 months
Outcomes	**Outcomes assessed:** • Mean IOP • Visual acuity • Number of antiglaucoma medications • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative weeks 1 and 2, and months 1, 3, 6, 9, and 12; the paper reported analysis of 6-month data only
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** Not reported

Wilson 1992 *(Continued)*

Reported subgroup analyses: Participants without neovascular glaucoma

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization was performed using a random number table; randomization was stratified for the following groups in blocks of 10: phakic, neovascular, aphakic or pseudophakic with intact posterior lens capsule, and pseudophakic without an intact posterior lens capsule.
Allocation concealment (selection bias)	Low risk	Type of treatment method selected was sealed in sequentially numbered envelopes until needed.
Masking of outcome assessment (detection bias) Primary outcome	High risk	Follow-up evaluation was performed by the surgeon involved.
Masking of outcome assessment (detection bias) Secondary outcomes	High risk	Follow-up evaluation was performed by the surgeon involved.
Incomplete outcome data (attrition bias) Primary outcome	High risk	16 participants excluded from all analyses (6 lost to follow-up, 9 who had not yet reached 6 months of follow-up, 1 withdrew due to development of sympathetic ophthalmia).
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	16 participants excluded from all analyses (6 lost to follow-up, 9 who had not yet reached 6 months of follow-up, 1 withdrew due to development of sympathetic ophthalmia).
Selective reporting (reporting bias)	High risk	Study was planned for 12 months but only 6-month data are reported.
Other bias	Low risk	No other risk of bias identified.

Wilson 2000

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 117 total participants; 55 in Ahmed group and 62 in trabeculectomy group **Losses to follow-up at one year:** 31 total; 15 in Ahmed group and 16 in trabeculectomy group **Intention-to-treat analysis:** no; participants were excluded from analysis at time of loss to follow-up
Participants	**Country:** Saudi Arabia, Sri Lanka **Age (years at baseline):** Mean ± SD in Ahmed group: 52.6 ± 18.6 (n = 55); mean ± SD in trabeculectomy group: 51.8 ± 17.2 (n = 62) **Gender:** 17 (31%) men and 38 (69%) women in Ahmed group; 20 (32%) men and 42 (68%) women in trabeculectomy group **Inclusion criteria:** Participants requiring glaucoma surgery for control of IOP

Wilson 2000 *(Continued)*

	Exclusion criteria: Participants requiring combined surgery; unable or unwilling to maintain follow-up; age younger than 4 years; visual acuity of no light perception **Equivalence of baseline characteristics:** All baseline characteristics (age, gender, glaucoma subtype, visual acuity, visual field scores) were statistically similar between the 2 groups except for number of glaucoma medications (P = 0.04) **Diagnoses in participants:** Primary open-angle glaucoma, primary angle-closure glaucoma, neovascular glaucoma, uveitic glaucoma, traumatic glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve **Intervention 2:** Trabeculectomy **General treatment:** All implants placed in superotemporal quadrant and covered with pericardium or donor sclera; trabeculectomies were performed with limbal-based flap with MMC usage left to surgeon discretion **Length of follow-up:** 11 to 13 months
Outcomes	**Primary outcomes:** • Success: IOP > 5 mmHg and < 21 mmHg with at least 15% reduction from baseline, no need for further glaucoma surgery, no loss of light perception, no loss of visual acuity • Failure: IOP < 5 mmHg or > 21 mmHg or with < 15% reduction from baseline on at least 2 consecutive examinations **Secondary outcomes:** • Mean IOP • Visual acuity • Visual field • Cataract formation • Anterior chamber depth • Glaucoma medication requirement • Operative and postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative day 1, days 7 to 14, weeks 6 to 15, months 5 to 7, and months 11 to 13
Notes	**Type of study:** Published **Funding:** Not reported; Ahmed valve implants were provided by New World Medical, Inc. **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization performed by computer-generated list of random numbers.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.

Wilson 2000 *(Continued)*

Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all prespecified outcomes were reported.
Other bias	Low risk	No other risk of bias identified.

Wilson 2003

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 123 total participants; 59 in Ahmed group and 64 in trabeculectomy group **Losses to follow-up:** not reported **Intention-to-treat analysis:** no; denominator for postoperative complications was different than denominator for baseline characteristics, suggesting that participants were excluded at time of loss to follow-up
Participants	**Country:** Sri Lanka **Age (years at baseline):** Mean ± SD in Ahmed group: 52.0 ± 18.9 (n = 59); mean ± SD in trabeculectomy group: 51.9 ± 16.4 (n = 64) **Gender:** 18 (31%) men and 41 (69%) women in Ahmed group; 21 (33%) men and 43 (67%) women in trabeculectomy group **Inclusion criteria:** Primary open-angle glaucoma or primary chronic angle-closure glaucoma requiring surgical intervention **Exclusion criteria:** Causes of glaucoma other than those stated in inclusion criteria; eyes with prior intraocular surgery; eyes with visual acuity of no light perception; requirement for combined surgery; age younger than 4 years; inability to maintain follow-up for a prolonged period **Equivalence of baseline characteristics:** Yes; age, gender, diagnosis, IOP, number of medications, visual acuity, visual field scores, and lens grading were similar at baseline between groups **Diagnoses in participants:** Primary open-angle glaucoma, primary chronic angle-closure glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model S2 **Intervention 2:** Trabeculectomy

Wilson 2003 *(Continued)*

	General treatment: All implants placed in superotemporal quadrant and covered with pericardium or donor sclera; trabeculectomies were performed with limbal-based flap with MMC usage left to surgeon discretion **Length of follow-up:** 50 to 52 months
Outcomes	**Primary outcomes:** • Success: IOP > 5 mmHg and < 21 mmHg with at least 15% reduction from baseline, no need for further glaucoma surgery, no loss of light perception, no loss of visual acuity • Failure: IOP < 5 mmHg or > 21 mmHg or with < 15% reduction from baseline on at least 2 consecutive examinations **Secondary outcomes:** • Mean IOP • Visual acuity • Visual field • Cataract formation • Anterior chamber depth • Glaucoma medication requirement • Operative and postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative day 1, days 7 to 14, weeks 6 to 15, months 5 to 7, months 11 to 13, months 14 to 18, months 20 to 24, months 25 to 30, months 34 to 40, months 41 to 46, and months 50 to 52
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** Not reported **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization performed by computer-generated list of random numbers.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Unclear risk	Masking of primary outcome assessors not reported.
Masking of outcome assessment (detection bias) Secondary outcomes	Unclear risk	Masking of secondary outcome assessors not reported.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.

Wilson 2003 *(Continued)*

Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants were excluded from analyses after loss to follow-up; no imputation methods were used.
Selective reporting (reporting bias)	Low risk	Results for all prespecified outcomes were reported in analysis.
Other bias	Low risk	No other risk of bias identified.

Yazdani 2016

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized (total and per group):** 75 total participants; 25 in Ahmed with amniotic membrane group, 25 in standard Ahmed group, and 25 in Ahmed with MMC group (excluded from this review) **Number analyzed (total and per group):** 20 in Ahmed with amniotic membrane group and 23 in standard Ahmed group **Losses to follow-up:** 5 in Ahmed with amniotic membrane group and 2 in standard Ahmed group **Intention-to-treat analysis:** no, participants lost to follow-up after randomization were not included in the analysis
Participants	**Country:** Iran **Age (years at baseline):** Mean ± SD in Ahmed with amniotic membrane group: 37.7 ± 19.4 (n = 20); mean ± SD in standard Ahmed group: 33.3 ± 20.1 (n = 23) **Gender:** 10 (50%) men and 10 (50%) women in Ahmed with amniotic membrane group; 13 (57%) men and 10 (43%) women in standard Ahmed group **Inclusion criteria:** Aged 7 to 75 years with glaucoma scheduled for Ahmed glaucoma valve implantation **Exclusion criteria:** Poor compliance with follow-up; previous Ahmed valve implantation; concomitant procedures such as deep vitrectomy or cataract surgery; catastrophic intraoperative or postoperative complications (e.g. suprachoroidal hemorrhage, retinal detachment, endophthalmitis) **Equivalence of baseline characteristics:** Yes; age, gender, number of previous surgeries, visual acuity, IOP, number of medications, and glaucoma subtype were similar between all 3 groups at baseline **Diagnoses in participants:** Inflammatory glaucoma, juvenile open-angle glaucoma, combined-mechanism glaucoma, aphakic glaucoma, primary congenital glaucoma, pseudophakic glaucoma, neovascular glaucoma, primary open-angle glaucoma, chronic angle-closure glaucoma, pseudoexfoliation glaucoma, developmental glaucoma, arteriovenous fistula, ghost cell glaucoma, traumatic glaucoma, steroid-induced glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP7, with amniotic membrane transplantation **Intervention 2:** Ahmed glaucoma valve without amniotic membrane **General treatment:** Quadrant of implant varied, all conjunctival flaps were fornix-based, all plates covered with scleral patch graft, subconjunctival betamethasone and cefazolin given at end of surgery; postoperative topical antibiotics for 1 week and steroids tapered over 6 to 8 weeks **Length of follow-up:** 12 months

Yazdani 2016 *(Continued)*

Outcomes	**Primary outcomes:** • Complete success: IOP 6 to 21 mmHg without any glaucoma medications • Partial success: IOP 6 to 21 mmHg with maximum of 2 glaucoma drops • Failure: IOP > 21 mmHg, < 21 mmHg with ≥ 3 medications, loss of vision, shunt extrusion, need for additional glaucoma surgery **Secondary outcomes:** • Mean IOP • Visual acuity • Number of glaucoma medications • Postoperative complications **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative weeks 1, 2, 3, 4, and 6, and months 3, 6, 9, and 12
Notes	**Type of study:** Published **Funding:** Not reported **Study period:** May 2009 to September 2012 **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization performed using stratified random block permutation method with block length of 3.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not reported.
Masking of outcome assessment (detection bias) Primary outcome	Low risk	Participants, examiner evaluating outcome measures, and biostatistician were masked to surgical assignment.
Masking of outcome assessment (detection bias) Secondary outcomes	Low risk	Participants, examiner evaluating outcome measures, and biostatistician were masked to surgical assignment.
Incomplete outcome data (attrition bias) Primary outcome	High risk	Participants lost to follow-up after randomization were excluded from all analyses.
Incomplete outcome data (attrition bias) Secondary outcomes	High risk	Participants lost to follow-up after randomization were excluded from all analyses.
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported in the analysis.
Other bias	Low risk	No other risk of bias identified.

Yuen 2011

Methods	**Study design:** parallel-group, randomized controlled trial **Unit of randomization:** individual (1 study eye per person) **Number randomized and analyzed (total and per group):** 28 total participants; 13 in Ahmed with ketorolac group and 15 in Ahmed with dexamethasone group **Losses to follow-up:** none **Intention-to-treat analysis:** n/a, no losses to follow-up
Participants	**Country:** Canada **Age (years at baseline):** Mean ± SD in Ahmed with ketorolac group: 64.2 ± 17.7 (n = 13); mean ± SD in Ahmed with dexamethasone group: 62.9 ± 10.9 (n = 15) **Gender:** 7 (54%) men and 6 (46%) women in Ahmed with ketorolac group; 6 (40%) men and 9 (60%) women in Ahmed with dexamethasone group **Inclusion criteria:** People scheduled for Ahmed valve surgery age 18 years or older **Exclusion criteria:** Combined glaucoma and cataract surgery; ocular condition that may have required more topical anti-inflammatory therapy (e.g. uveitic glaucoma, previous penetrating keratoplasty); pregnant or planning to become pregnant during study period; breastfeeding; known allergy to ketorolac or other non-steroidal anti-inflammatory agents **Equivalence of baseline characteristics:** Yes; age, gender, visual acuity, IOP, and number of medications were similar at baseline between groups **Diagnoses in participants:** Primary open-angle glaucoma, secondary open-angle glaucoma, angle-closure glaucoma, neovascular glaucoma, other glaucoma
Interventions	**Intervention 1:** Ahmed glaucoma valve, model FP7, with postoperative 0.5% ketorolac **Intervention 2:** Ahmed glaucoma valve, model FP7, with postoperative 0.1% dexamethasone **General treatment:** 2 surgeons performed all surgeries; 1 surgeon used limbal-based flap and peribulbar anesthesia, while the other used fornix-based flap and retrobulbar anesthesia; ketorolac and dexamethasone were given 4 times a day for 6 weeks followed by taper based on clinical judgement; all participants received topical atropine and tobramycin for 1 week following surgery **Length of follow-up:** 3 months
Outcomes	**Primary outcome:** • Mean IOP **Secondary outcomes:** • Incidence and severity of hypertensive phase (HP) (HP defined as IOP > 21 mmHg after initial postoperative reduction to < 22 mmHg) • Mean time to appearance of HP • Visual acuity • Number of glaucoma medications • Postoperative complications • Subsequent procedures **Reported adverse effects:** Yes, complications were reported **Other issues with outcome assessment:** Outcomes were assessed at postoperative weeks 1, 2, 4, 6, 8, 10, and 12

Yuen 2011 *(Continued)*

Notes	**Type of study:** Published **Funding:** Internal departmental funding from Toronto Western Hospital Department of Ophthalmology **Study period:** 1 October 2008 to 30 September 2009 **Reported subgroup analyses:** None reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomization scheme not reported.
Allocation concealment (selection bias)	Unclear risk	Randomization scheme not reported.
Masking of outcome assessment (detection bias) Primary outcome	Low risk	Investigators and study participants were masked to treatment assignment.
Masking of outcome assessment (detection bias) Secondary outcomes	Low risk	Investigators and study participants were masked to treatment assignment.
Incomplete outcome data (attrition bias) Primary outcome	Low risk	No losses to follow-up
Incomplete outcome data (attrition bias) Secondary outcomes	Low risk	No losses to follow-up
Selective reporting (reporting bias)	Low risk	All prespecified outcomes were reported in analysis.
Other bias	Low risk	No other risk of bias identified.

IOP: intraocular pressure
MMC: mitomycin C
SD: standard deviation

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bettis 2015	Retrospective comparative case series
El Gendy 2012	Retrospective comparative case series
El Sayed 2013	Prospective matched comparative study
Goulet 2008	Retrospective comparative case series

Study	Reason for exclusion
Lankaranian 2008	Retrospective comparative case series
Law 2005	Retrospective comparative case series
Martino 2015	Retrospective matched comparative case series
Pakravan 2009	Prospective parallel-cohort study
Poels 2013	Retrospective comparative case series
Rachmiel 2008	Retrospective comparative case series
Robert 2013	Retrospective comparative case series
Rososinski 2015	Retrospective comparative case series
Shen 2011	Retrospective comparative case series
Suhr 2012	Retrospective comparative case series
Taglia 2002	Retrospective comparative case series
Thompson 2013	Retrospective comparative series with historical controls
Tran 2009	Retrospective matched case series
Trubnik 2015	Retrospective case-control study
Tsai 2006	Retrospective comparative case series

Characteristics of studies awaiting assessment *[ordered by study ID]*

Chen 1998

Methods	
Participants	
Interventions	
Outcomes	
Notes	Not enough information in conference abstract

ChiCTR-TRC-09000744

Methods	
Participants	
Interventions	

ChiCTR-TRC-09000744 *(Continued)*

Outcomes	
Notes	Recruitment status of trial is unknown, no publications to date.

Fenton 1993

Methods	
Participants	
Interventions	
Outcomes	
Notes	Not enough information in conference abstract

NCT00453024

Methods	
Participants	
Interventions	
Outcomes	
Notes	Recruitment status of trial is unknown, no publications to date.

NCT00491712

Methods	
Participants	
Interventions	
Outcomes	
Notes	Recruitment status of trial is unknown, no publications to date.

NCT00644280

Methods	
Participants	
Interventions	

NCT00644280 *(Continued)*

Outcomes	
Notes	Study terminated due to low recruitment, no publications to date.

NCT00665756

Methods	
Participants	
Interventions	
Outcomes	
Notes	Recruitment status of trial is unknown, no publications to date.

NCT01301378

Methods	
Participants	
Interventions	
Outcomes	
Notes	Registered trial that terminated, related publications are retrospective data only.

Rodrigues 2006

Methods	
Participants	
Interventions	
Outcomes	
Notes	Not enough information in conference abstract

Characteristics of ongoing studies *[ordered by study ID]*

ChiCTR-IOR-16008954

Trial name or title	**Repeat trabeculectomy versus Ahmed glaucoma valve implantation of primary open angle glaucoma with failed initial trabeculectomy**
Methods	**Unit of randomization:** Not specified

ChiCTR-IOR-16008954 *(Continued)*

	Number randomized: 156 planned
Participants	**Country:** China **Inclusion criteria:** Age 18 to 70 years, primary open-angle glaucoma with history of trabeculectomy with failure of primary bleb, IOP ≥ 18 mmHg after maximal ocular hypotensive agents, open angle by gonioscopy, progressive visual field defect and/or missing retinal ganglion cells and axons, voluntarily signed informed consent, no surgery and anesthesia contraindications **Exclusion criteria:** Unwilling to enroll in study or follow-up; target IOP achieved by bleb needling; leaking bleb; risk of bleb related entophthalmia; high myopia; no light perception; conjunctival scarring from causes other than trabeculectomy; uncontrollable ocular surface infection; heart, liver, and kidney function damage; severe gastrointestinal disease; mental abnormalities; diabetic; contraindication to glucocorticoid on ocular surface; history or planned intraocular operation other than trabeculectomy; secondary glaucoma; cannot tolerate surgery or anesthesia
Interventions	**Treatment:** Repeat trabeculectomy **Control:** Ahmed glaucoma valve
Outcomes	Not specified
Starting date	June 2016
Contact information	Mingkai Lin Zhongshan Ophthalmic Center, Sun Yat-sen University 54 South Xianlie Road, Guangzhou, China
Notes	**Estimated completion date:** June 2021 **Follow-up duration:** 5 years

ChiCTR-IPR-15006695

Trial name or title	**Adjunctive with intravitreal injection of ranibizumab before Ahmed glaucoma valve implantation in the treatment of neovascular glaucoma: a prospective randomized controlled study**
Methods	**Unit of randomization:** Not specified **Number randomized:** 92 planned
Participants	**Country:** China **Inclusion criteria:** Provide informed consent and can follow up, older than 18 years, people with neovascularization of the iris and the anterior chamber angle and with an established diagnosis of neovascular glaucoma, IOP of 22 mmHg or more on maximally tolerated medical therapy **Exclusion criteria:** Unwilling or unable to provide informed consent to participate in the study or to adhere to the study requirements, neovascular glaucoma secondary to intraocular tumors or uveitis, earlier cyclodestructive procedure, scleral buckle procedure, previous glaucoma drainage device implantation or silicone oil surgery, pregnancy, no light perception
Interventions	**Treatment:** Ahmed glaucoma valve with adjunctive ranibizumab **Control:** Ahmed glaucoma valve with adjunctive bevacizumab
Outcomes	**Primary outcome:**

ChiCTR-IPR-15006695 *(Continued)*

	• IOP **Secondary outcomes:** • Number of glaucoma medications • Visual acuity • Postoperative complications
Starting date	January 2016
Contact information	Minwen Zhou Shanghai First People's Hospital 100 Haining Road, Shanghai, China
Notes	**Estimated completion date:** January 2020 **Follow-up duration:** 4 years

NCT00666237

Trial name or title	**Primary tube versus trabeculectomy study**
Methods	**Unit of randomization:** Not specified **Number randomized:** 250 planned
Participants	**Country:** USA, Canada, UK **Inclusion criteria:** Age 18 to 85 years, glaucoma that is inadequately controlled on tolerated medical therapy with IOP ≥ 18 mmHg and ≤ 40 mmHg, no previous incisional ocular surgery **Exclusion criteria:** Unwilling or unable to give consent, unwilling to accept randomization, or unable to return for scheduled protocol visits; pregnant or nursing women; no light perception vision; active iris neovascularization or active proliferative retinopathy; iridocorneal endothelial syndrome; epithelial or fibrous ingrowth; chronic or recurrent uveitis; steroid-induced glaucoma; severe posterior blepharitis; unwilling to discontinue contact lens use after surgery; previous cyclodestructive procedure; conjunctival scarring from prior ocular trauma or cicatrizing disease precluding a superior trabeculectomy; functionally significant cataract; need for glaucoma surgery combined with other ocular procedures or anticipated need for additional ocular surgery
Interventions	**Treatment:** 350 mm^2 Baerveldt implant **Control:** Trabeculectomy with mitomycin C 0.4 mg/mL for 2 minutes
Outcomes	**Primary outcome:** • IOP **Secondary outcomes:** • Postoperative complications • Visual acuity • Visual fields • Reoperation for glaucoma • Supplemental medical therapy

NCT00666237 *(Continued)*

Starting date	April 2008
Contact information	Steven J Gedde, MD Bascom Palmer Eye Institute Miami, Florida, USA 33136
Notes	**Estimated completion date:** April 2016 **Follow-up duration:** 5 years **Sponsors and collaborators:** Abbott Medical Optics, Inc., Research to Prevent Blindness, Inc., National Eye Institute, Bascom Palmer Eye Institute, University of California Davis, University of Florida, Johns Hopkins University, St. Louis University, New York Eye and Ear Infirmary, Cincinnati Eye Institute, University of Oklahoma, University of Pennsylvania, Glaucoma Associates of Texas, University of Texas Houston, University of Virginia, University of Toronto, Moorfields Eye Hospital, St. Thomas' Hospital, Queen Mary's Sidcup Hospital

NCT01159314

Trial name or title	**Baerveldt Plate Area Comparison (BPAC)**
Methods	**Unit of randomization:** Individual **Number randomized:** 270 planned
Participants	**Country:** USA **Inclusion criteria:** Age over 18 years; IOP > 18 mmHg and < 40 mmHg on medical therapy; previous ocular surgery limited to cataract, corneal transplant, trabeculectomy, vitrectomy; consent signed **Exclusion criteria:** Unwilling or unable to give consent, unwilling to accept randomization, or unable to return for scheduled protocol visits; pregnant or nursing; no light perception; iris neovascularization or proliferative retinopathy; epithelial or fibrous downgrowth; chronic or recurrent uveitis; steroid-induced glaucoma; severe posterior blepharitis; previous cyclodestructive procedure; conjunctival scarring from prior ocular trauma or cicatrizing disease precluding Baerveldt implantation; functionally significant cataract; need for Baerveldt implant combined with other ocular procedures or anticipated need for additional ocular surgery; prior glaucoma drainage device implant; prior retinal surgery with remaining silicone oil; prior scleral buckling procedures
Interventions	**Treatment:** Baerveldt 250 mm^2 implant **Control:** Baerveldt 350 mm^2 implant
Outcomes	**Primary outcome:** • Visual acuity **Secondary outcomes:** • None specified
Starting date	June 2010
Contact information	Michael V Boland, MD, PhD The Wilmer Eye Institute

NCT01159314 *(Continued)*

	Baltimore, Maryland, USA 21287
Notes	**Estimated completion date:** June 2017 **Follow-up duration:** 5 years **Sponsors and collaborators:** Johns Hopkins University, University of California Davis, University of Miami, Mount Sinai School of Medicine, Wills Eye Institute

NCT01494974

Trial name or title	**Comparison of the Ahmed glaucoma valve FP7 and FP8 in pediatric glaucoma**
Methods	**Unit of randomization:** Not specified **Number randomized:** 40 planned
Participants	**Country:** Brazil **Inclusion criteria:** Diagnosis of pediatric glaucoma with indication for Ahmed glaucoma valve implantation; age 0 to 10 years old **Exclusion criteria:** Age older than 10 years
Interventions	**Treatment:** Ahmed glaucoma valve, model FP7 **Control:** Ahmed glaucoma valve, model FP8
Outcomes	**Primary outcome:** • Position of drainage implant (success if plate is ≥ 8 mm from the corneal limbus after 1 year of surgery) **Secondary outcomes:** • Complete success: IOP ≤ 21 mmHg and > 5 mmHg and 30% reduction from baseline without glaucoma medications • Qualified success: IOP ≤ 21 mmHg and > 5 mmHg and 30% reduction from baseline with glaucoma medications • Failure: IOP ≤ 5 mmHg or > 21 mmHg, need for further surgery, loss of light perception
Starting date	December 2011
Contact information	Camila Fonseca Netto, MD Federal University of São Paulo São Paulo, Brazil 04023-062
Notes	**Estimated completion date:** December 2015 **Follow-up duration:** 12 months **Sponsors and collaborators:** Federal University of São Paulo

NCT01535768

Trial name or title	**Effect of prophylactic aqueous suppression on hyperencapsulation of Ahmed glaucoma valves**
Methods	**Unit of randomization:** Individual **Number randomized:** 150 planned
Participants	**Country:** Canada **Inclusion criteria:** Clinical diagnosis of glaucoma; scheduled for Ahmed glaucoma valve surgery with or without cataract surgery **Exclusion criteria:** Neovascular glaucoma; uveitic glaucoma; prior tube shunt surgery; prior cyclodestructive procedure; abnormal cornea that would make IOP measurements unreliable; sulfa allergy; systemic contraindications to acetazolamide use; inability to attend follow-up visits; IOP greater than 21 at postoperative week 1 (represents primary failure of the valve); anterior chamber fill within the first week postoperatively
Interventions	**Treatment:** Ahmed glaucoma valve with postoperative aqueous suppressant eye drops in a step-wise fashion to maintain IOP 7 to 10 mmHg **Control:** Ahmed glaucoma valve with no postoperative aqueous suppression in the first 3 months unless the bleb hyperencapsulates
Outcomes	**Primary outcome:** • Washout IOP at 4 months postoperative (all glaucoma eye drops will be stopped at 3 months post-operative in all study participants) **Secondary outcomes:** • Hyperencapsulation phase: IOP increase by 5 mmHg or greater compared to previous visit, bleb appearance of encapsulation (raised, thick, firm, dome-shaped), no other reason for IOP increase • Qualified success: IOP ≤ 18 mmHg at 12 months with glaucoma medications • Absolute success: IOP ≤ 18 mmHg at 13 months without glaucoma medications (medications will be stopped at 12 months so IOP will be washout) • Number of glaucoma medications
Starting date	February 2012
Contact information	Amandeep S Rai, MD Credit Valley Eye Care Mississauga, Ontario, Canada L5L1W8
Notes	**Estimated completion date:** June 2017 **Follow-up duration:** 12 months **Sponsors and collaborators:** Credit Valley Eye Care, Canadian Glaucoma Clinical Research Council

NCT01551550

Trial name or title	**Shunt Tube Exposure Prevention Study (STEPS)**
Methods	**Unit of randomization:** Not specified

NCT01551550 *(Continued)*

	Number randomized: 96 planned
Participants	**Country:** USA **Inclusion criteria:** Uncontrolled glaucoma undergoing glaucoma drainage device implantation with (a) primary open-angle glaucoma with previous conjunctival cutting surgery or (b) secondary glaucoma; age 21 to 80 years old; both genders and all ethnic groups comparable with the local community; people able and willing to co-operate with investigational plan; people able and willing to complete postoperative follow-up; people able to understand and willing to sign a written informed consent **Exclusion criteria:** Ocular infection within 14 days prior to study entry; no light perception vision; previous cyclodestructive procedure; children under 21; active drug or alcohol use or dependence that, in the opinion of the site investigator, would interfere with adherence to study requirements; inability or unwillingness of person or legal guardian/representative to give written informed consent
Interventions	**Treatment:** Glaucoma drainage device with amniotic membrane graft **Control:** Glaucoma drainage device with pericardial graft
Outcomes	**Primary outcome:** • Tube exposure **Secondary outcomes:** • Failure: IOP ≥ 21 mmHg or not reduced by 30% below baseline on 2 consecutive follow-up visits after 3 months; IOP ≤ 5 mmHg on 2 consecutive follow-up visits after 3 months; additional glaucoma surgery; loss of light perception
Starting date	June 2013
Contact information	Hosam El Sheha, MD, PhD Tissue Tech, Inc.
Notes	**Estimated completion date:** August 2015 **Follow-up duration:** 3 months **Sponsors and collaborators:** Tissue Tech, Inc., National Eye Institute, Bascom Palmer Eye Institute, New York Eye and Ear Infirmary, Columbia University

NCT01883856

Trial name or title	**Comparison of silicone and porous plate Ahmed glaucoma valves**
Methods	**Unit of randomization:** Not specified **Number randomized:** 88 planned
Participants	**Country:** USA **Inclusion criteria:** Male or female of any race ≥ 18 and ≤ 80 years of age; diagnosis of intractable glaucoma in the study eye, with the exception of silicone oil endotamponade-induced glaucoma, which has not responded to conventional medical and surgical therapy; elevated IOP > 21 mmHg in the study eye; person is a candidate for surgery in the study eye with a glaucoma drainage device; person is willing and able to sign the informed consent

NCT01883856 *(Continued)*

	Exclusion criteria: Diagnosis of silicone oil endotamponade-induced glaucoma in the study eye; history of prior drainage implant surgery in the study eye; history of cyclophotocoagulation of the study eye; pregnancy; prison
Interventions	**Treatment:** Porous plate Ahmed glaucoma valve **Control:** Silicone plate Ahmed glaucoma valve
Outcomes	**Primary outcome:** • Mean IOP **Secondary outcomes:** • Number of glaucoma medications • Surgical success (definition not specified)
Starting date	February 2012
Contact information	Peter A Netland, MD, PhD University of Virginia Charlottesville, Virginia, USA 22903
Notes	**Estimated completion date:** June 2015 **Follow-up duration:** 12 months **Sponsors and collaborators:** University of Virginia; New World Medical, Inc.

NCT01915706

Trial name or title	**The effect of scheduled ripcord removal on the outcomes of Baerveldt 350 implants**
Methods	**Unit of randomization:** Individual **Number randomized:** 50 planned
Participants	**Country:** USA **Inclusion criteria:** Men or women aged 18 years or older at screening; inadequately controlled glaucoma refractory to maximum therapy; suitable candidate for Baerveldt 350 implant in the superotemporal quadrant in the study eye; capable and willing to provide consent **Exclusion criteria:** Unable or unwilling to provide consent; any previous ocular surgery other than cataract extraction or trabeculectomy; any previous ocular surgeries in the study eye preventing placement of the Baerveldt 350 implant in the superotemporal quadrant; any abnormality other than glaucoma in the study eye that could affect tonometry; presence or history of any abnormality or disorder that could interfere with the study procedure or prevent the successful completion of the study; best-corrected visual acuity in the non-operative eye worse than 20/200; any significant unstable cardiovascular, hepatic, renal, respiratory, gastrointestinal, endocrine, immunologic, dermatologic, hematologic, neurologic, or psychiatric disease; known pregnant or breastfeeding women
Interventions	**Treatment:** Baerveldt implant with scheduled ripcord removal at postoperative week 3 **Control:** Baerveldt implant without ripcord removal unless deemed medically necessary by physician

NCT01915706 *(Continued)*

Outcomes	**Primary outcome:** • Postoperative complications **Secondary outcomes:** • Unqualified success: IOP 6 to 18 mmHg or 25% reduction from baseline without glaucoma medication • Qualified success: IOP 6 to 18 mmHg or 25% reduction from baseline with glaucoma medication
Starting date	September 2013
Contact information	Leon Herndon, MD Duke Eye Center Durham, North Carolina, USA 27710
Notes	**Estimated completion date:** July 2013 **Follow-up duration:** 6 months **Sponsors and collaborators:** Duke University

NCT02084745

Trial name or title	**Timing of glaucoma drainage device with Boston KPro Surgery (GDD-KPro)**
Methods	**Unit of randomization:** Individual **Number randomized:** 60 planned
Participants	**Country:** Canada **Inclusion criteria:** Candidate for corneal transplantation due to loss of corneal clarity; verifiable history of 1 or more previous full-thickness donor corneal transplantation failure; preoperative visual acuity ≤ 20/80 or worse in the surgical eye; age ≥ 18 years; physical condition suitable for undergoing surgery **Exclusion criteria:** Terminal glaucoma, terminal retinal diseases
Interventions	**Treatment:** Simultaneous Ahmed glaucoma valve implantation at time of Boston keratoprosthesis surgery **Control:** Implantation of Ahmed glaucoma valve 6 months after Boston keratoprosthesis surgery
Outcomes	**Primary outcome:** • Visual field mean deviation **Secondary outcomes:** • Disc Damage Likelihood Scale (DDLS) on clinical examination • DDLS on stereoscopic photographs of the optic nerve • Ocular complications • Visual acuity
Starting date	March 2014

NCT02084745 *(Continued)*

Contact information	Mona Harissi-Dagher, MD, FRCSC Department of Ophthalmology Centre Hospitalier de l'Université de Montréal Montreal, Quebec, Canada
Notes	**Estimated completion date:** March 2017 **Follow-up duration:** 12 months **Sponsors and collaborators:** Centre Hospitalier de l'Université de Montréal (CHUM); Centre de Recherche du Centre Hospitalier de l'Université de Montréal

NCT02088528

Trial name or title	**The Ghana Primary Tube Versus Trabeculectomy Study (GPTVT)**
Methods	**Unit of randomization:** Not specified **Number randomized:** 298 planned
Participants	**Country:** Ghana **Inclusion criteria:** Age 18 to 85 years, inclusive; open-angle glaucoma including primary open-angle glaucoma, pseudoexfoliative glaucoma, and pigmentary glaucoma; IOP 18 to 40 mmHg on maximal tolerated or maximal affordable medical therapy; informed consent given and consent form signed **Exclusion criteria:** Unwilling or unable to give consent, unwilling to accept randomization, or unable to return for scheduled protocol visits; pregnant or nursing women; no light perception vision; previous incisional intraocular surgery other than uncomplicated clear corneal cataract surgery; previous ocular laser in study eye; iris neovascularization or proliferative retinopathy; primary angle-closure or primary angle-closure glaucoma; iridocorneal endothelial syndrome or anterior segment dysgenesis; epithelial or fibrous downgrowth; aphakia; chronic or recurrent uveitis; steroid-induced glaucoma; severe posterior blepharitis; unwilling to discontinue contact lens use after surgery; previous cyclodestructive procedure; glaucoma secondary to penetrating keratoplasty, trauma, retinal disease/surgery, or neovascular disease; conjunctival scarring from prior ocular surgery, trauma, or cicatrizing disease precluding a superior trabeculectomy; need for glaucoma surgery combined with other ocular procedures or anticipated need for urgent additional ocular surgery
Interventions	**Treatment:** Aurolab glaucoma drainage device **Control:** Trabeculectomy with mitomycin C 0.4 mg/mL for 3 minutes
Outcomes	**Primary outcome:** • Change in IOP **Secondary outcomes:** • Postoperative complications • Visual acuity • Visual field • Reoperation for glaucoma • Supplemental medical therapy

NCT02088528 *(Continued)*

	• Quality of life
Starting date	March 2015
Contact information	Alexander Spratt, MBBCh, FRCOphth Tema Christian Eye Center, Tema, Ghana
Notes	**Estimated completion date:** March 2021 **Follow-up duration:** 5 years **Sponsors and collaborators:** Tema Christian Eye Center, International Glaucoma Association, HCA International Foundation, Moorfields Eye Hospital, University of North Carolina Chapel Hill

NTR1142

Trial name or title	**Primary Baerveldt glaucoma implant versus trabeculectomy study**
Methods	**Unit of randomization:** Not specified **Number randomized:** Not specified
Participants	**Country:** Netherlands **Inclusion criteria:** Age 18 to 75 years; informed consent; Caucasian (understood to be white); expected to complete follow-up of 5 years; primary open-angle glaucoma, pseudoexfoliative glaucoma, or pigmentary glaucoma; indication for IOP-lowering surgery **Exclusion criteria:** IOP exacerbating glaucoma by further delay of pressure reduction (because implant remains closed until 6 weeks postop, assigning such a participant to the Baerveldt group would be unethical)
Interventions	**Treatment:** Baerveldt glaucoma implant **Control:** Trabeculectomy
Outcomes	**Primary outcome:** • IOP **Secondary outcome:** • Need for glaucoma medications • Visual acuity • Motility disorder • Laser flare count • Postoperative complications
Starting date	November 2007
Contact information	Dr PWT Waard Oogziekenhuis Rotterdam (OZR) Stichting Wetenschappelijk Onderzoek het Oogziekenhuis
Notes	**Completion date:** December 2015

NTR1142 *(Continued)*

Follow-up duration: 8 years

IOP: intraocular pressure

DATA AND ANALYSES

Comparison 1. Aqueous shunts versus trabeculectomy for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 At 6 months follow-up	1	195	Mean Difference (IV, Random, 95% CI)	0.70 [-0.75, 2.15]
1.2 At 1 year follow-up	3	380	Mean Difference (IV, Random, 95% CI)	2.55 [-0.78, 5.87]
1.3 At 3 years follow-up	1	141	Mean Difference (IV, Random, 95% CI)	-0.30 [-2.27, 1.67]
1.4 At 4 years follow-up	1	110	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.5 At 5 years follow-up	1	124	Mean Difference (IV, Random, 95% CI)	1.80 [-0.46, 4.06]
2 Intraocular pressure outcomes at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Intraocular pressure outcomes at 3 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Intraocular pressure outcomes at 5 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5 Mean difference in logMAR visual acuity	3		Mean Difference (Random, 95% CI)	Subtotals only
5.1 At 1 year follow-up	3	380	Mean Difference (Random, 95% CI)	0.12 [-0.07, 0.31]
5.2 At 3 years follow-up	1	157	Mean Difference (Random, 95% CI)	0.04 [-0.17, 0.25]
5.3 At 4 years follow-up	1	110	Mean Difference (Random, 95% CI)	-0.88 [-2.17, 0.41]
5.4 At 5 years follow-up	1	143	Mean Difference (Random, 95% CI)	0.2 [-0.08, 0.48]
6 Mean change in visual field	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 At 1 year follow-up	2	196	Mean Difference (IV, Fixed, 95% CI)	-0.25 [-1.91, 1.40]
6.2 At 4 years follow-up	1	110	Mean Difference (IV, Fixed, 95% CI)	-5.02 [-5.65, -4.39]
7 Mean antiglaucoma medications	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
7.1 At 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.2 At 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.3 At 3 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.4 At 5 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
8 Need for reoperation to control glaucoma progression	3		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
8.1 At 1 year follow-up	2	329	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.04, 1.36]
8.2 At 3 years follow-up	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.49 [0.19, 1.26]
8.3 At 4 years follow-up	1	123	Risk Ratio (M-H, Fixed, 95% CI)	2.17 [0.41, 11.41]
8.4 At 5 years follow-up	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.44 [0.20, 0.96]
9 Complications at 1 year follow-up	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
9.1 Total participants with complications	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.59 [0.43, 0.81]
9.2 Flat anterior chamber	2	329	Risk Ratio (M-H, Fixed, 95% CI)	1.05 [0.62, 1.79]
9.3 Choroidal effusion	2	329	Risk Ratio (M-H, Fixed, 95% CI)	1.67 [0.89, 3.14]
9.4 Hyphema	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.45, 2.80]
9.5 Persistent corneal edema	1	212	Risk Ratio (M-H, Fixed, 95% CI)	2.29 [0.61, 8.62]

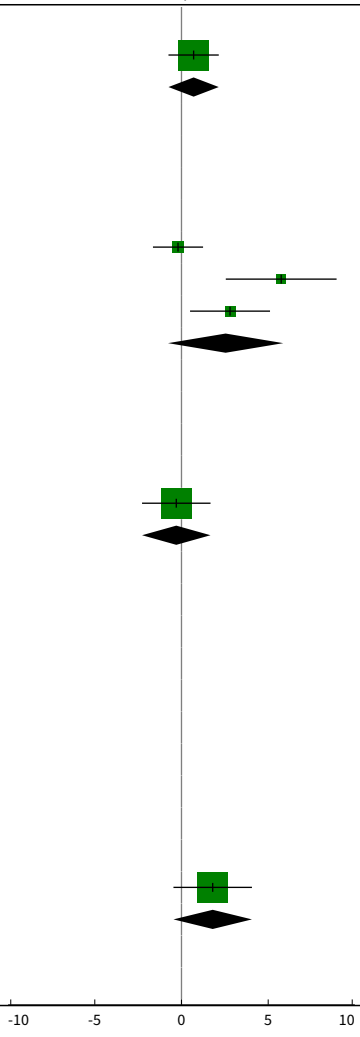
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.6 Cystoid macular edema	1	212	Risk Ratio (M-H, Fixed, 95% CI)	1.47 [0.25, 8.63]
9.7 Bleb leak	2	329	Risk Ratio (M-H, Fixed, 95% CI)	0.19 [0.03, 1.06]
9.8 Encapsulated bleb	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.07, 1.58]
9.9 Endophthalmitis/blebitis	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.03, 3.09]
9.10 Chronic/recurrent iritis	1	212	Risk Ratio (M-H, Fixed, 95% CI)	1.96 [0.18, 21.32]
9.11 Corneal ulcer	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 7.94]
9.12 Infection	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.13 Dysesthesia	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.14 [0.02, 1.12]
9.14 Persistent diplopia	1	212	Risk Ratio (M-H, Fixed, 95% CI)	10.80 [0.60, 192.83]
9.15 Hypotony	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.07, 17.60]
9.16 Hypotony maculopathy	1	212	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.03, 3.09]
9.17 Implant exposure	1	117	Risk Ratio (M-H, Fixed, 95% CI)	5.63 [0.28, 114.68]
9.18 Tube misdirection	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
9.19 Retinal detachment	1	212	Risk Ratio (M-H, Fixed, 95% CI)	2.94 [0.12, 71.47]
9.20 Suprachoroidal hemorrhage	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10 Complications at 3 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
10.1 Total participants with complications	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.2 Flat anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.3 Choroidal effusion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.4 Persistent corneal edema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.5 Cystoid macular edema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.6 Bleb leak	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.7 Encapsulated bleb	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.8 Endophthalmitis/blebitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.9 Chronic/recurrent iritis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
10.10 Corneal ulcer	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.11 Dysesthesia	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.12 Persistent diplopia	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.13 Hypotony maculopathy	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
10.14 Retinal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11 Complications at 4 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
11.1 Flat anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.2 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.3 Bleb leak	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.4 Endophthalmitis/blebitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.5 Corneal ulcer	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.6 Implant exposure	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.7 Tube misdirection	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
11.8 Suprachoroidal hemorrhage	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12 Complications at 5 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
12.1 Flat anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.2 Choroidal effusion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.3 Persistent corneal edema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.4 Cystoid macular edema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.5 Bleb leak	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.6 Encapsulated bleb	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.7 Endophthalmitis/blebitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.8 Chronic/recurrent iritis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.9 Corneal ulcer	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
12.10 Dysesthesia	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.11 Persistent diplopia	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.12 Hypotony maculopathy	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
12.13 Retinal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

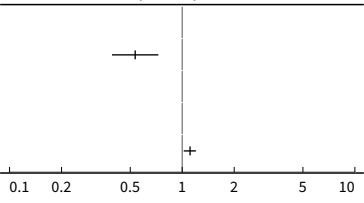
Analysis 1.1. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 1 Mean intraocular pressure.

Study or subgroup	Aqueous shunt N	Aqueous shunt Mean(SD)	Trabeculectomy N	Trabeculectomy Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
1.1.1 At 6 months follow-up							
TVT 2009	102	13.5 (4.2)	93	12.8 (5.9)		100%	0.7[-0.75,2.15]
Subtotal ***	**102**		**93**			**100%**	**0.7[-0.75,2.15]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.95(P=0.34)							
1.1.2 At 1 year follow-up							
TVT 2009	97	12.5 (3.9)	87	12.7 (5.8)		37.21%	-0.2[-1.64,1.24]
Wilson 2000	40	17.2 (8.7)	46	11.4 (5.9)		29.22%	5.75[2.56,8.94]
Wilson 2003	52	16.6 (7.2)	58	13.8 (4.7)		33.56%	2.8[0.49,5.11]
Subtotal ***	**189**		**191**			**100%**	**2.55[-0.78,5.87]**
Heterogeneity: Tau^2=7.19; Chi^2=13.22, df=2(P=0); I^2=84.87%							
Test for overall effect: Z=1.5(P=0.13)							
1.1.3 At 3 years follow-up							
TVT 2009	74	13 (4.9)	67	13.3 (6.8)		100%	-0.3[-2.27,1.67]
Subtotal ***	**74**		**67**			**100%**	**-0.3[-2.27,1.67]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.3(P=0.77)							
1.1.4 At 4 years follow-up							
Wilson 2003	52	13.1 (0)	58	13.6 (0)			Not estimable
Subtotal ***	**52**		**58**				**Not estimable**
Heterogeneity: Not applicable							
Test for overall effect: Not applicable							
1.1.5 At 5 years follow-up							
TVT 2009	61	14.4 (6.9)	63	12.6 (5.9)		100%	1.8[-0.46,4.06]
Subtotal ***	**61**		**63**			**100%**	**1.8[-0.46,4.06]**
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%							
Test for overall effect: Z=1.56(P=0.12)							



Analysis 1.2. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 2 Intraocular pressure outcomes at 1 year follow-up.

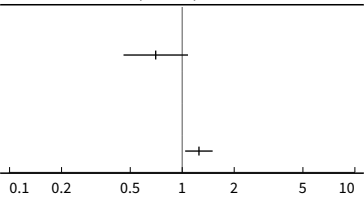
Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.2.1 Complete success				
TVT 2009	35/104	63/100		0.53[0.39,0.73]
1.2.2 Qualified or complete success				
TVT 2009	100/104	87/100		1.11[1.02,1.2]



Favors trabeculectomy — Favors aqueous shunt

Analysis 1.3. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 3 Intraocular pressure outcomes at 3 years follow-up.

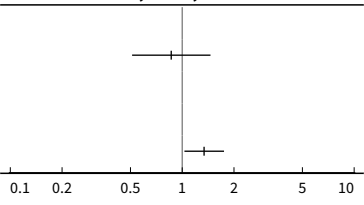
Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.3.1 Complete success				
TVT 2009	24/85	33/82		0.7[0.46,1.08]
1.3.2 Qualified or complete success				
TVT 2009	70/85	54/82		1.25[1.04,1.5]



Favors trabeculectomy — Favors aqueous shunt

Analysis 1.4. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 4 Intraocular pressure outcomes at 5 years follow-up.

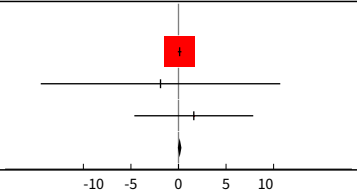
Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.4.1 Complete success				
TVT 2009	18/73	24/84		0.86[0.51,1.46]
1.4.2 Qualified or complete success				
TVT 2009	49/73	42/84		1.34[1.03,1.75]



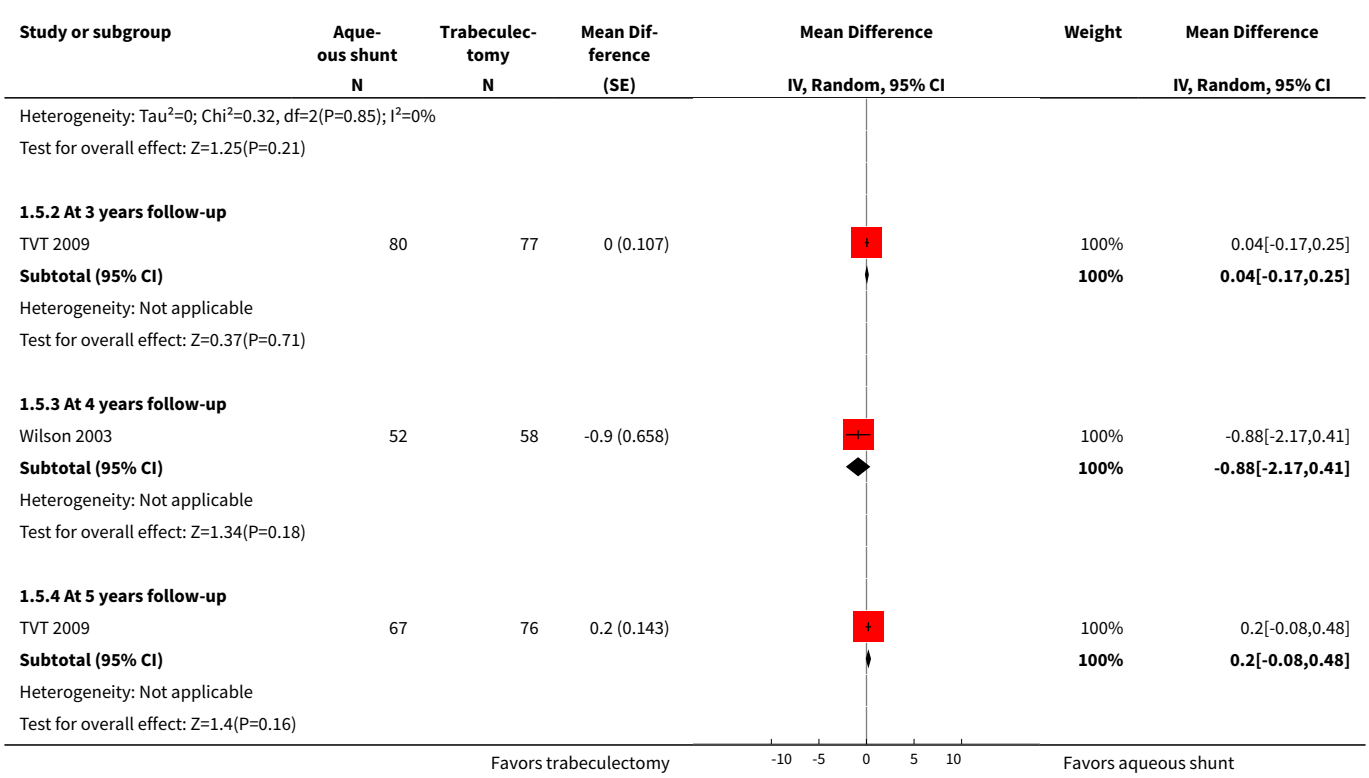
Favors trabeculectomy — Favors aqueous shunt

Analysis 1.5. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 5 Mean difference in logMAR visual acuity.

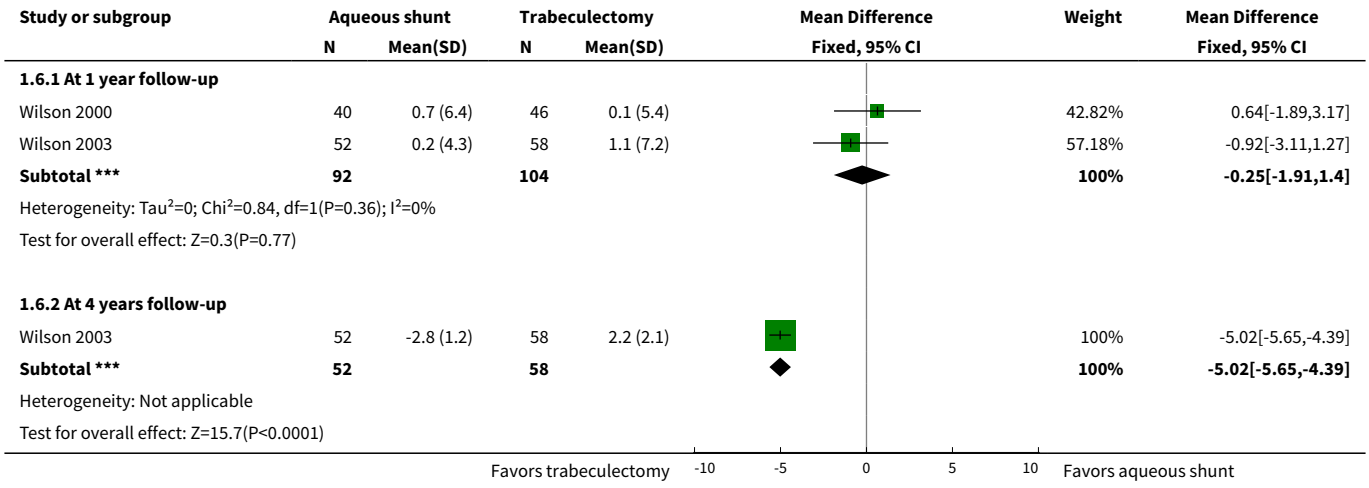
Study or subgroup	Aqueous shunt N	Trabeculectomy N	Mean Difference (SE)	Mean Difference IV, Random, 95% CI	Weight	Mean Difference IV, Random, 95% CI
1.5.1 At 1 year follow-up						
TVT 2009	97	87	0.1 (0.097)		99.89%	0.12[-0.07,0.31]
Wilson 2000	40	46	-1.9 (6.424)		0.02%	-1.89[-14.48,10.7]
Wilson 2003	52	58	1.6 (3.189)		0.09%	1.61[-4.64,7.86]
Subtotal (95% CI)					**100%**	**0.12[-0.07,0.31]**



Favors trabeculectomy — Favors aqueous shunt



Analysis 1.6. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 6 Mean change in visual field.

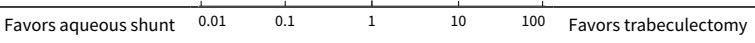


Analysis 1.7. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 7 Mean antiglaucoma medications.

Study or subgroup	Aqueous shunt N	Aqueous shunt Mean(SD)	Trabeculectomy N	Trabeculectomy Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
1.7.1 At 6 months follow-up						
TVT 2009	102	1.2 (1.2)	93	0.6 (1.1)		0.6[0.28,0.92]
1.7.2 At 1 year follow-up						
TVT 2009	97	1.3 (1.3)	87	0.5 (0.9)		0.8[0.48,1.12]
1.7.3 At 3 years follow-up						
TVT 2009	74	1.3 (1.3)	67	1 (1.5)		0.3[-0.17,0.77]
1.7.4 At 5 years follow-up						
TVT 2009	61	1.4 (1.3)	63	1.2 (1.5)		0.2[-0.29,0.69]

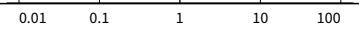
Analysis 1.8. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 8 Need for reoperation to control glaucoma progression.

Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
1.8.1 At 1 year follow-up					
TVT 2009	1/107	5/105		78.14%	0.2[0.02,1.65]
Wilson 2000	0/55	1/62		21.86%	0.38[0.02,9.02]
Subtotal (95% CI)	**162**	**167**		**100%**	**0.24[0.04,1.36]**
Total events: 1 (Aqueous shunt), 6 (Trabeculectomy)					
Heterogeneity: Tau^2=0; Chi^2=0.11, df=1(P=0.74); I^2=0%					
Test for overall effect: Z=1.62(P=0.11)					
1.8.2 At 3 years follow-up					
TVT 2009	6/107	12/105		100%	0.49[0.19,1.26]
Subtotal (95% CI)	**107**	**105**		**100%**	**0.49[0.19,1.26]**
Total events: 6 (Aqueous shunt), 12 (Trabeculectomy)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=1.48(P=0.14)					
1.8.3 At 4 years follow-up					
Wilson 2003	4/59	2/64		100%	2.17[0.41,11.41]
Subtotal (95% CI)	**59**	**64**		**100%**	**2.17[0.41,11.41]**
Total events: 4 (Aqueous shunt), 2 (Trabeculectomy)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=0.91(P=0.36)					
1.8.4 At 5 years follow-up					
TVT 2009	8/107	18/105		100%	0.44[0.2,0.96]
Subtotal (95% CI)	**107**	**105**		**100%**	**0.44[0.2,0.96]**
Total events: 8 (Aqueous shunt), 18 (Trabeculectomy)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.06(P=0.04)					



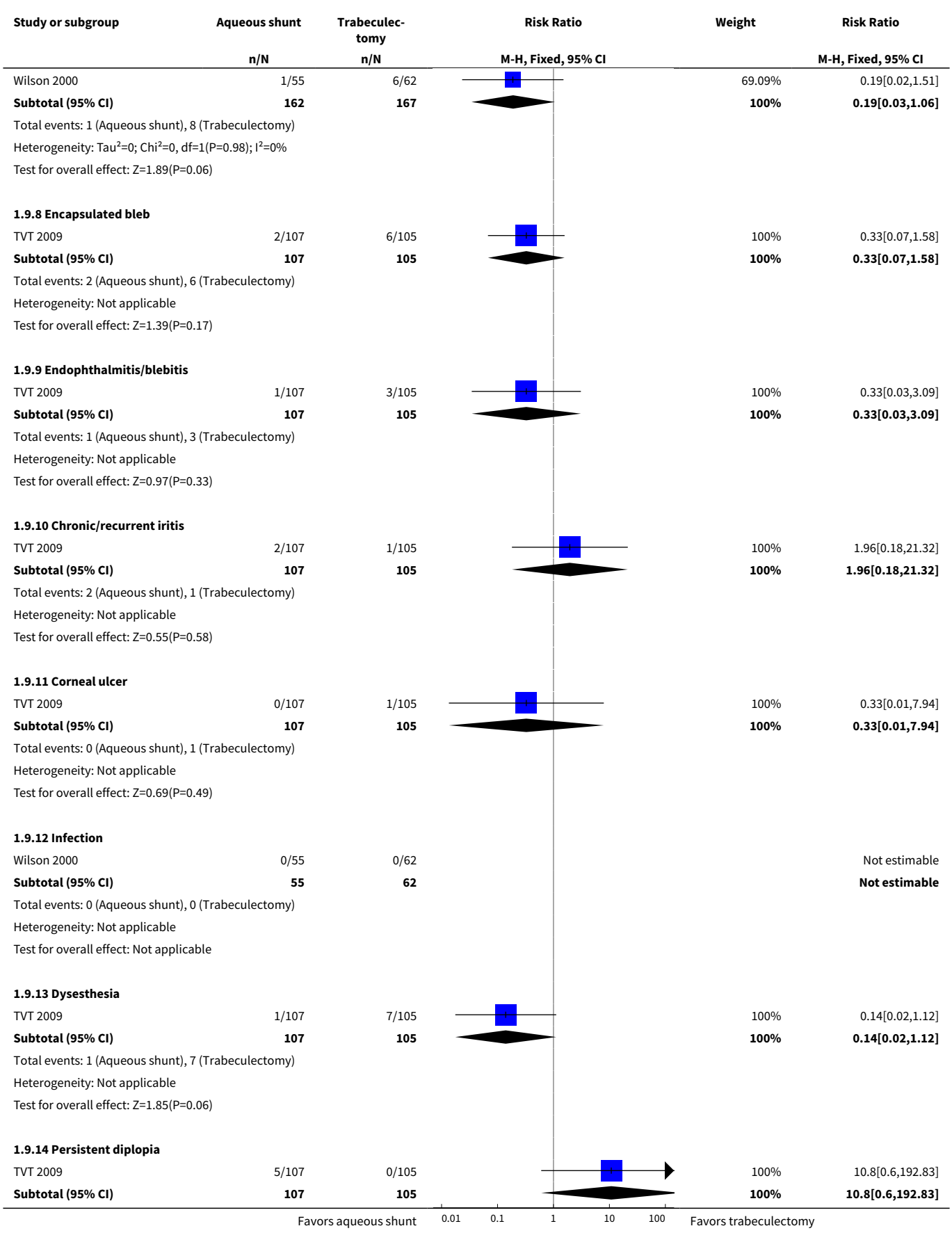
Analysis 1.9. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 9 Complications at 1 year follow-up.

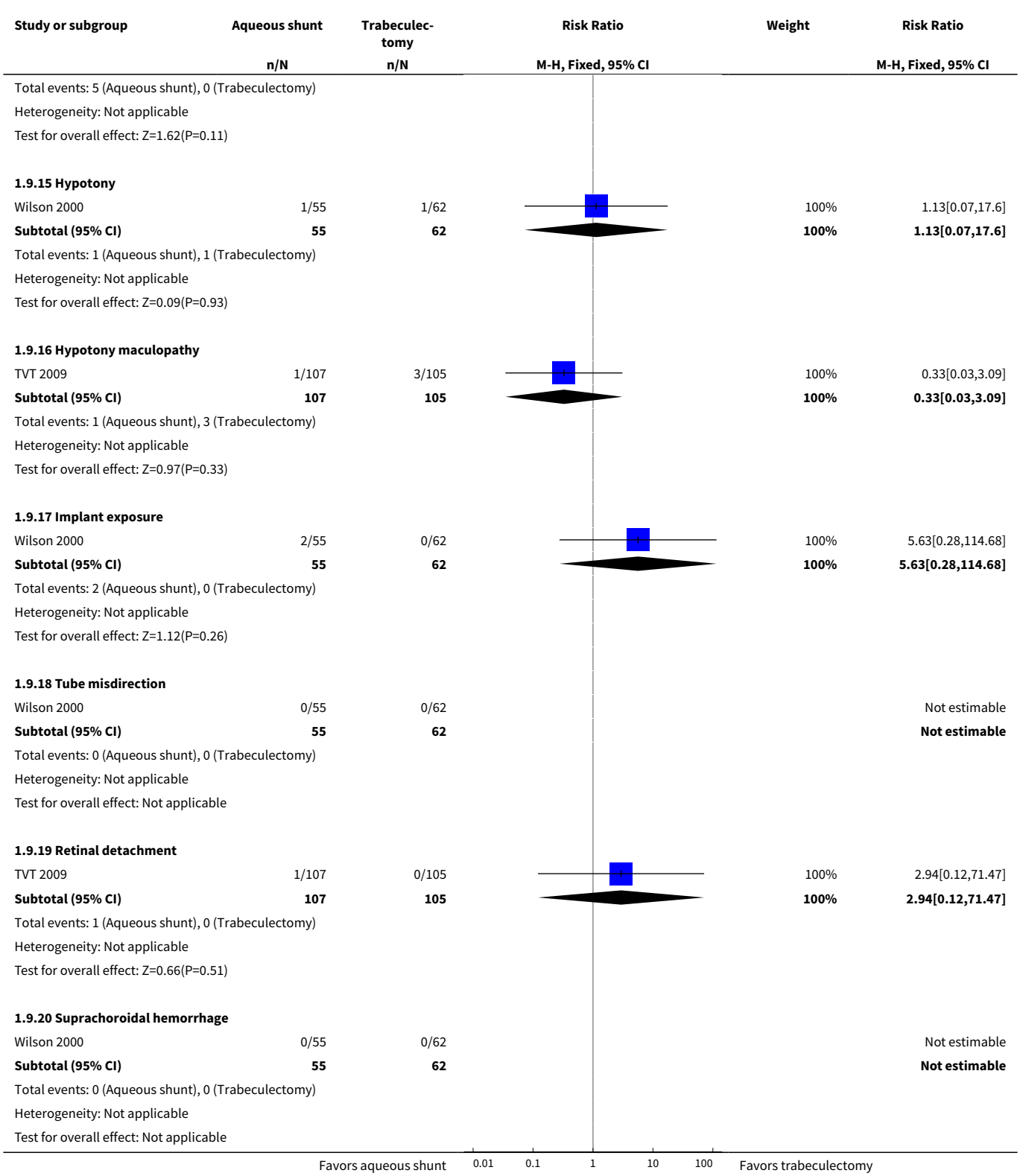
Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
1.9.1 Total participants with complications					
TVT 2009	36/107	60/105		100%	0.59[0.43,0.81]
Subtotal (95% CI)	**107**	**105**		**100%**	**0.59[0.43,0.81]**
Total events: 36 (Aqueous shunt), 60 (Trabeculectomy)					
Heterogeneity: Not applicable					
Test for overall effect: Z=3.31(P=0)					
1.9.2 Flat anterior chamber					
TVT 2009	12/107	12/105		53.94%	0.98[0.46,2.08]
Wilson 2000	11/55	11/62		46.06%	1.13[0.53,2.39]
Subtotal (95% CI)	**162**	**167**		**100%**	**1.05[0.62,1.79]**
Total events: 23 (Aqueous shunt), 23 (Trabeculectomy)					
Heterogeneity: Tau^2=0; Chi^2=0.07, df=1(P=0.8); I^2=0%					
Test for overall effect: Z=0.17(P=0.86)					
1.9.3 Choroidal effusion					
TVT 2009	17/107	10/105		72.86%	1.67[0.8,3.47]
Wilson 2000	6/55	4/62		27.14%	1.69[0.5,5.68]
Subtotal (95% CI)	**162**	**167**		**100%**	**1.67[0.89,3.14]**
Total events: 23 (Aqueous shunt), 14 (Trabeculectomy)					
Heterogeneity: Tau^2=0; Chi^2=0, df=1(P=0.99); I^2=0%					
Test for overall effect: Z=1.61(P=0.11)					
1.9.4 Hyphema					
Wilson 2000	8/55	8/62		100%	1.13[0.45,2.8]
Subtotal (95% CI)	**55**	**62**		**100%**	**1.13[0.45,2.8]**
Total events: 8 (Aqueous shunt), 8 (Trabeculectomy)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.26(P=0.8)					
1.9.5 Persistent corneal edema					
TVT 2009	7/107	3/105		100%	2.29[0.61,8.62]
Subtotal (95% CI)	**107**	**105**		**100%**	**2.29[0.61,8.62]**
Total events: 7 (Aqueous shunt), 3 (Trabeculectomy)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.23(P=0.22)					
1.9.6 Cystoid macular edema					
TVT 2009	3/107	2/105		100%	1.47[0.25,8.63]
Subtotal (95% CI)	**107**	**105**		**100%**	**1.47[0.25,8.63]**
Total events: 3 (Aqueous shunt), 2 (Trabeculectomy)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.43(P=0.67)					
1.9.7 Bleb leak					
TVT 2009	0/107	2/105		30.91%	0.2[0.01,4.04]



Favors aqueous shunt

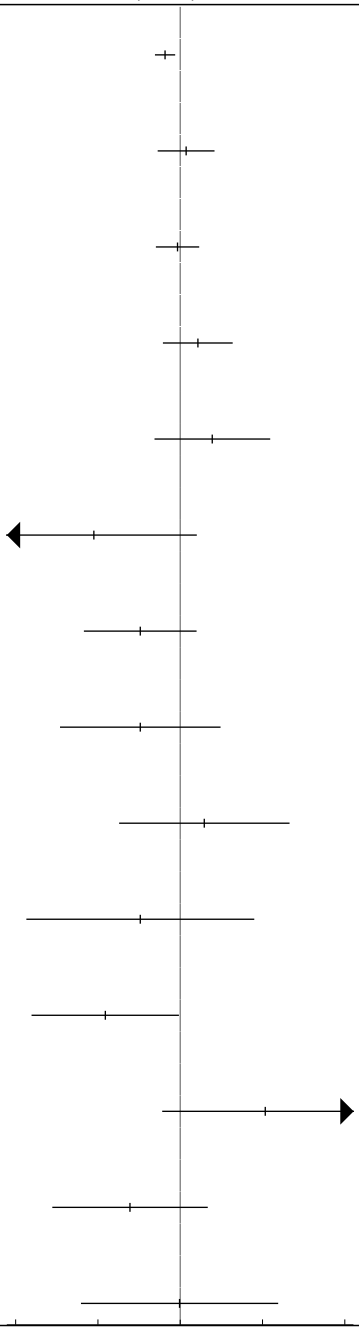
Favors trabeculectomy





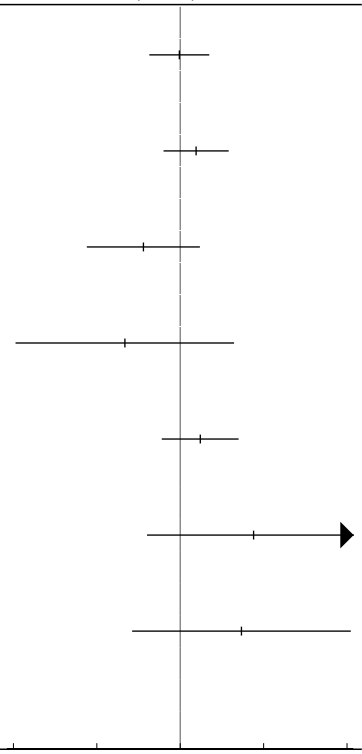
Analysis 1.10. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 10 Complications at 3 years follow-up.

Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.10.1 Total participants with complications				
TVT 2009	42/107	63/105		0.65[0.49,0.87]
1.10.2 Flat anterior chamber				
TVT 2009	12/107	10/105		1.18[0.53,2.61]
1.10.3 Choroidal effusion				
TVT 2009	17/107	18/105		0.93[0.51,1.7]
1.10.4 Persistent corneal edema				
TVT 2009	10/107	6/105		1.64[0.62,4.34]
1.10.5 Cystoid macular edema				
TVT 2009	5/107	2/105		2.45[0.49,12.37]
1.10.6 Bleb leak				
TVT 2009	0/107	5/105		0.09[0,1.59]
1.10.7 Encapsulated bleb				
TVT 2009	2/107	6/105		0.33[0.07,1.58]
1.10.8 Endophthalmitis/blebitis				
TVT 2009	1/107	3/105		0.33[0.03,3.09]
1.10.9 Chronic/recurrent iritis				
TVT 2009	2/107	1/105		1.96[0.18,21.32]
1.10.10 Corneal ulcer				
TVT 2009	0/107	1/105		0.33[0.01,7.94]
1.10.11 Dysesthesia				
TVT 2009	1/107	8/105		0.12[0.02,0.96]
1.10.12 Persistent diplopia				
TVT 2009	5/107	0/105		10.8[0.6,192.83]
1.10.13 Hypotony maculopathy				
TVT 2009	1/107	4/105		0.25[0.03,2.16]
1.10.14 Retinal detachment				
TVT 2009	1/107	1/105		0.98[0.06,15.48]



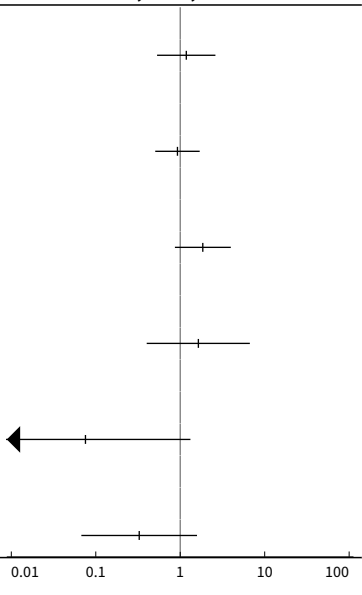
Analysis 1.11. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 11 Complications at 4 years follow-up.

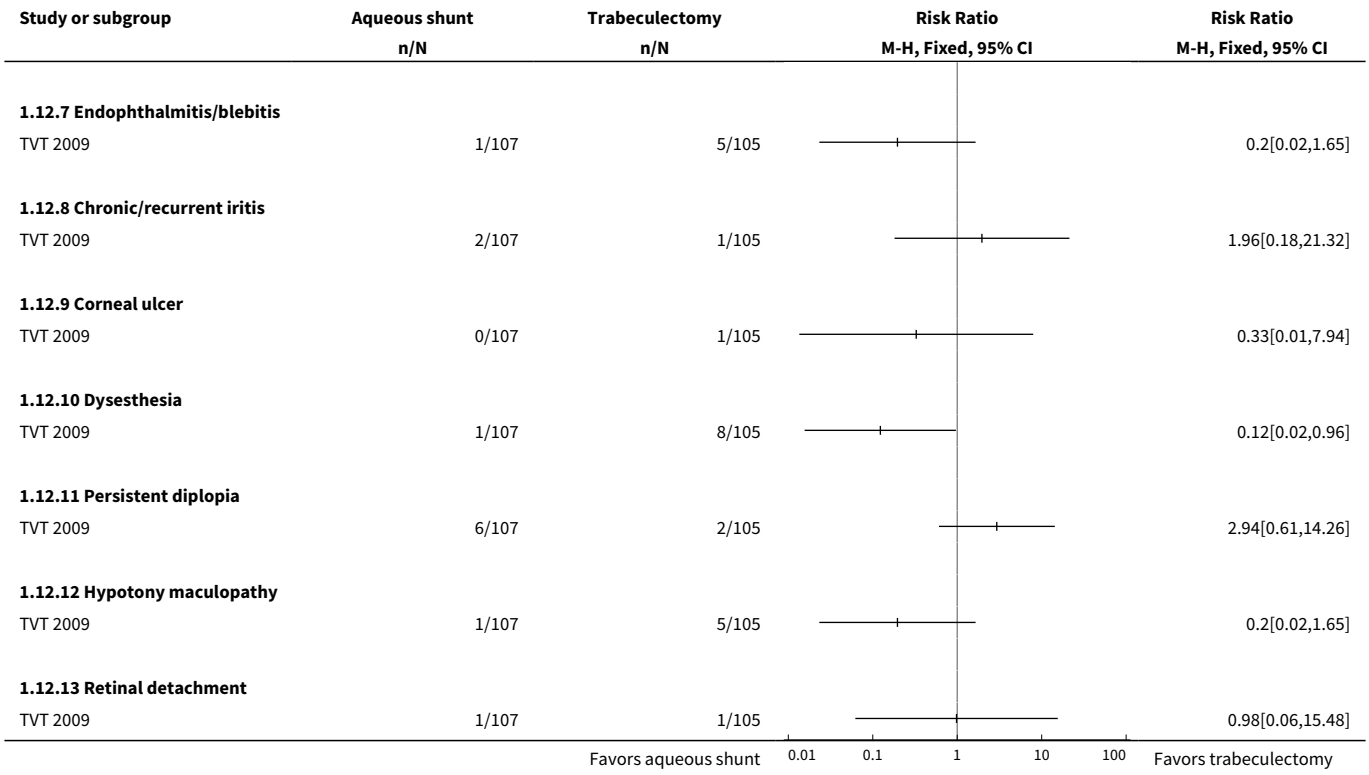
Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.11.1 Flat anterior chamber				
Wilson 2003	9/59	10/64		0.98[0.43,2.23]
1.11.2 Hyphema				
Wilson 2003	10/59	7/64		1.55[0.63,3.81]
1.11.3 Bleb leak				
Wilson 2003	2/59	6/64		0.36[0.08,1.72]
1.11.4 Endophthalmitis/blebitis				
Wilson 2003	0/59	2/64		0.22[0.01,4.42]
1.11.5 Corneal ulcer				
Wilson 2003	8/59	5/64		1.74[0.6,5.01]
1.11.6 Implant exposure				
Wilson 2003	3/59	0/64		7.58[0.4,143.78]
1.11.7 Tube misdirection				
Wilson 2003	2/59	0/64		5.42[0.27,110.55]
1.11.8 Suprachoroidal hemorrhage				
Wilson 2003	0/59	0/64		Not estimable



Analysis 1.12. Comparison 1 Aqueous shunts versus trabeculectomy for glaucoma, Outcome 12 Complications at 5 years follow-up.

Study or subgroup	Aqueous shunt n/N	Trabeculectomy n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
1.12.1 Flat anterior chamber				
TVT 2009	12/107	10/105		1.18[0.53,2.61]
1.12.2 Choroidal effusion				
TVT 2009	17/107	18/105		0.93[0.51,1.7]
1.12.3 Persistent corneal edema				
TVT 2009	17/107	9/105		1.85[0.87,3.97]
1.12.4 Cystoid macular edema				
TVT 2009	5/107	3/105		1.64[0.4,6.67]
1.12.5 Bleb leak				
TVT 2009	0/107	6/105		0.08[0,1.32]
1.12.6 Encapsulated bleb				
TVT 2009	2/107	6/105		0.33[0.07,1.58]





Comparison 2. Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 At 6 months follow-up	2	494	Mean Difference (IV, Fixed, 95% CI)	1.31 [0.25, 2.36]
1.2 At 1 year follow-up	2	464	Mean Difference (IV, Fixed, 95% CI)	2.60 [1.58, 3.62]
1.3 At 3 years follow-up	2	397	Mean Difference (IV, Fixed, 95% CI)	1.24 [0.31, 2.18]
1.4 At 5 years follow-up	1	174	Mean Difference (IV, Fixed, 95% CI)	2.0 [0.68, 3.32]
2 Mean logMAR visual acuity	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 At 1 year follow-up	2	501	Mean Difference (IV, Fixed, 95% CI)	-0.07 [-0.27, 0.13]
2.2 At 3 years follow-up	2	396	Mean Difference (IV, Fixed, 95% CI)	-0.02 [-0.25, 0.22]
2.3 At 5 years follow-up	1	173	Mean Difference (IV, Fixed, 95% CI)	-0.01 [-0.39, 0.37]
3 Mean number of antiglaucoma medications	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 At 6 months follow-up	2	494	Mean Difference (IV, Fixed, 95% CI)	0.50 [0.27, 0.73]

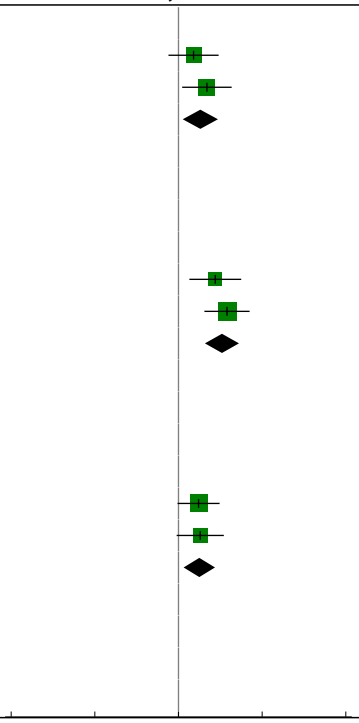
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.2 At 1 year follow-up	2	464	Mean Difference (IV, Fixed, 95% CI)	0.35 [0.11, 0.59]
3.3 At 3 years follow-up	2	397	Mean Difference (IV, Fixed, 95% CI)	0.60 [0.33, 0.87]
3.4 At 5 years follow-up	1	174	Mean Difference (IV, Fixed, 95% CI)	0.40 [-0.03, 0.83]
4 Need for reoperation to control glaucoma progression	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
4.1 At 1 year follow-up	2	514	Risk Ratio (M-H, Fixed, 95% CI)	2.77 [1.02, 7.54]
4.2 At 3 years follow-up	2	514	Risk Ratio (M-H, Fixed, 95% CI)	1.98 [1.08, 3.65]
4.3 At 5 years follow-up	1	276	Risk Ratio (M-H, Fixed, 95% CI)	2.67 [1.24, 5.77]
5 Complications at 1 year follow-up	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
5.1 Shallow anterior chamber	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.97 [0.67, 1.38]
5.2 Choroidal effusion	2	514	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.73, 1.76]
5.3 Iritis	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.55 [0.25, 1.23]
5.4 Corneal edema	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.46 [0.31, 0.69]
5.5 Encapsulated bleb	1	238	Risk Ratio (M-H, Fixed, 95% CI)	4.29 [1.27, 14.54]
5.6 Tube obstruction	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.36 [0.17, 0.77]
5.7 Tube malposition	1	238	Risk Ratio (M-H, Fixed, 95% CI)	1.84 [0.34, 9.85]
5.8 Tube erosion	2	514	Risk Ratio (M-H, Fixed, 95% CI)	2.77 [0.56, 13.61]
5.9 Motility disorder/diplopia	2	514	Risk Ratio (M-H, Fixed, 95% CI)	1.39 [0.82, 2.37]
5.10 Hyphema	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.59 [0.34, 1.01]
5.11 Hypotony maculopathy	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.40 [0.40, 4.84]
5.12 Malignant glaucoma	1	238	Risk Ratio (M-H, Fixed, 95% CI)	1.84 [0.17, 20.01]
5.13 Suprachoroidal hemorrhage	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.15 [0.02, 1.27]
5.14 Retinal/choroidal detachment	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.16, 3.08]
5.15 Endophthalmitis/episcleritis	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.16, 3.09]

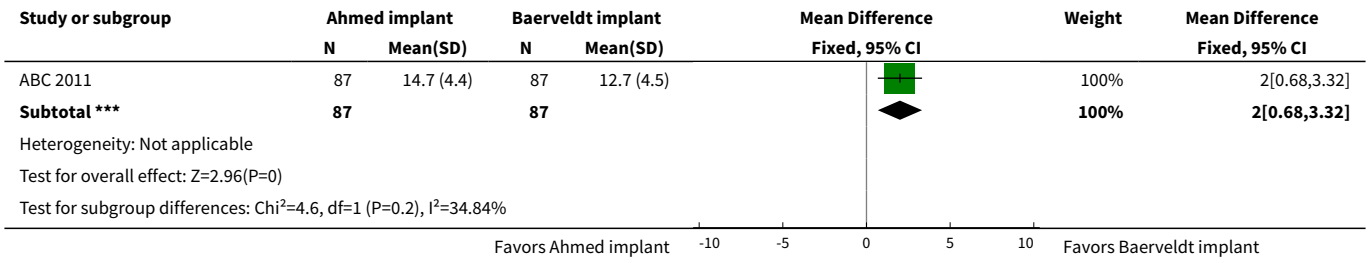
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.16 Cystoid macular edema	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.71 [0.65, 4.48]
6 Complications at 3 years follow-up	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
6.1 Shallow anterior chamber	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.64, 1.29]
6.2 Choroidal effusion	2	514	Risk Ratio (M-H, Fixed, 95% CI)	1.13 [0.73, 1.76]
6.3 Iritis	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.75 [0.37, 1.53]
6.4 Corneal edema	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.62 [0.43, 0.88]
6.5 Encapsulated bleb	2	514	Risk Ratio (M-H, Fixed, 95% CI)	4.08 [1.31, 12.72]
6.6 Tube obstruction	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.21 [0.07, 0.59]
6.7 Tube erosion	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.40 [0.11, 1.51]
6.8 Motility disorder/diplopia	2	514	Risk Ratio (M-H, Fixed, 95% CI)	1.24 [0.76, 2.02]
6.9 Hyphema	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.57 [0.33, 0.97]
6.10 Hypotony maculopathy	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.40 [0.40, 4.84]
6.11 Malignant glaucoma	1	238	Risk Ratio (M-H, Fixed, 95% CI)	0.92 [0.13, 6.42]
6.12 Suprachoroidal hemorrhage	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.15 [0.02, 1.27]
6.13 Retinal/choroidal detachment	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.56 [0.13, 2.30]
6.14 Endophthalmitis/episcleritis	2	514	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.16, 3.09]
6.15 Cystoid macular edema	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.73 [0.71, 4.20]
7 Complications at 5 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
7.1 Shallow anterior chamber	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.60, 1.44]
7.2 Choroidal effusion	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.36 [0.74, 2.52]
7.3 Iritis	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.09 [0.37, 3.15]
7.4 Corneal edema	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.48, 1.00]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7.5 Encapsulated bleb	1	276	Risk Ratio (M-H, Fixed, 95% CI)	2.79 [0.11, 67.94]
7.6 Tube obstruction	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.21 [0.07, 0.59]
7.7 Tube erosion	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.53 [0.16, 1.77]
7.8 Motility disorder/diplopia	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.11 [0.65, 1.88]
7.9 Hyphema	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.56 [0.31, 1.01]
7.10 Hypotony maculopathy	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.40 [0.40, 4.84]
7.11 Retinal/choroidal detachment	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.13, 6.51]
7.12 Endophthalmitis	1	276	Risk Ratio (M-H, Fixed, 95% CI)	0.13 [0.01, 2.55]
7.13 Cystoid macular edema	1	276	Risk Ratio (M-H, Fixed, 95% CI)	1.45 [0.65, 3.23]

Analysis 2.1. Comparison 2 Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma, Outcome 1 Mean intraocular pressure.

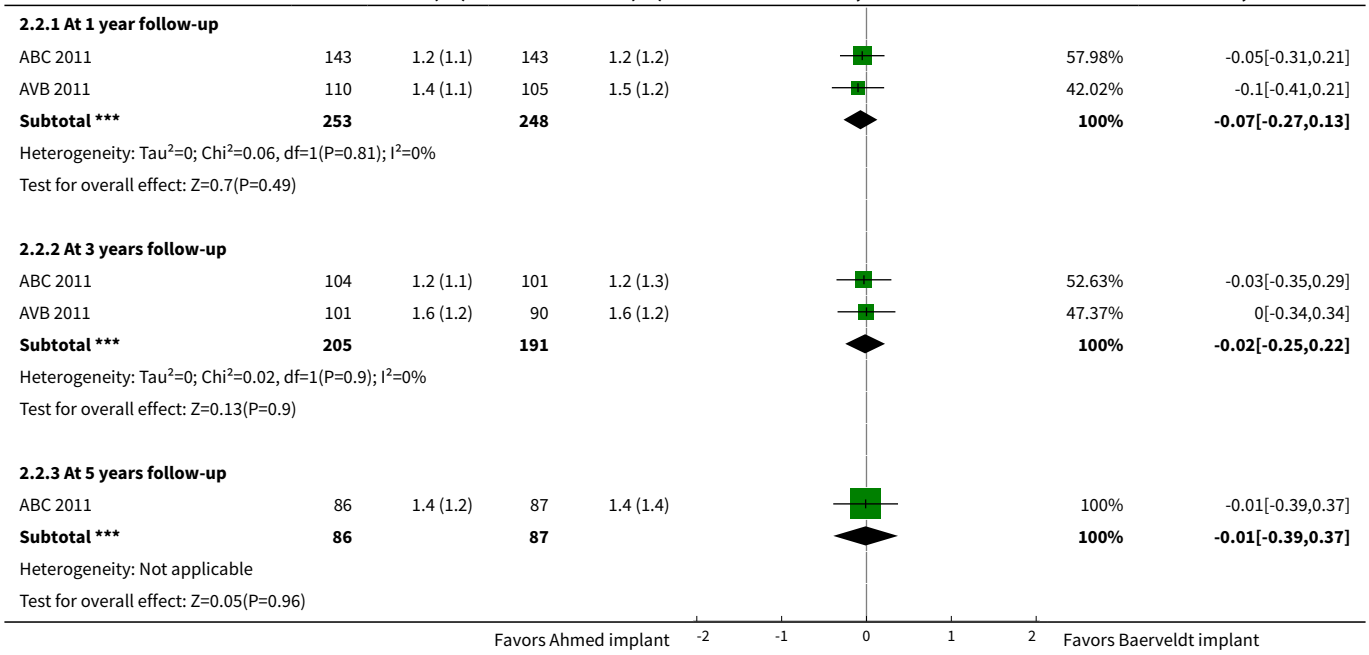
Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Baerveldt implant N	Baerveldt implant Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
2.1.1 At 6 months follow-up							
ABC 2011	131	15.7 (5.3)	125	14.8 (6.8)		49.34%	0.9[-0.6,2.4]
AVB 2011	124	16.7 (5.1)	114	15 (6.4)		50.66%	1.7[0.22,3.18]
Subtotal ***	**255**		**239**			**100%**	**1.31[0.25,2.36]**
Heterogeneity: Tau^2=0; Chi^2=0.55, df=1(P=0.46); I^2=0%							
Test for overall effect: Z=2.43(P=0.02)							
2.1.2 At 1 year follow-up							
ABC 2011	132	15.4 (5.5)	117	13.2 (6.8)		43.2%	2.2[0.65,3.75]
AVB 2011	110	16.5 (5.3)	105	13.6 (4.8)		56.8%	2.9[1.55,4.25]
Subtotal ***	**242**		**222**			**100%**	**2.6[1.58,3.62]**
Heterogeneity: Tau^2=0; Chi^2=0.45, df=1(P=0.5); I^2=0%							
Test for overall effect: Z=5(P<0.0001)							
2.1.3 At 3 years follow-up							
ABC 2011	106	14.3 (4.7)	100	13.1 (4.5)		55.72%	1.2[-0.06,2.46]
AVB 2011	101	15.7 (4.8)	90	14.4 (5.1)		44.28%	1.3[-0.11,2.71]
Subtotal ***	**207**		**190**			**100%**	**1.24[0.31,2.18]**
Heterogeneity: Tau^2=0; Chi^2=0.01, df=1(P=0.92); I^2=0%							
Test for overall effect: Z=2.6(P=0.01)							
2.1.4 At 5 years follow-up							





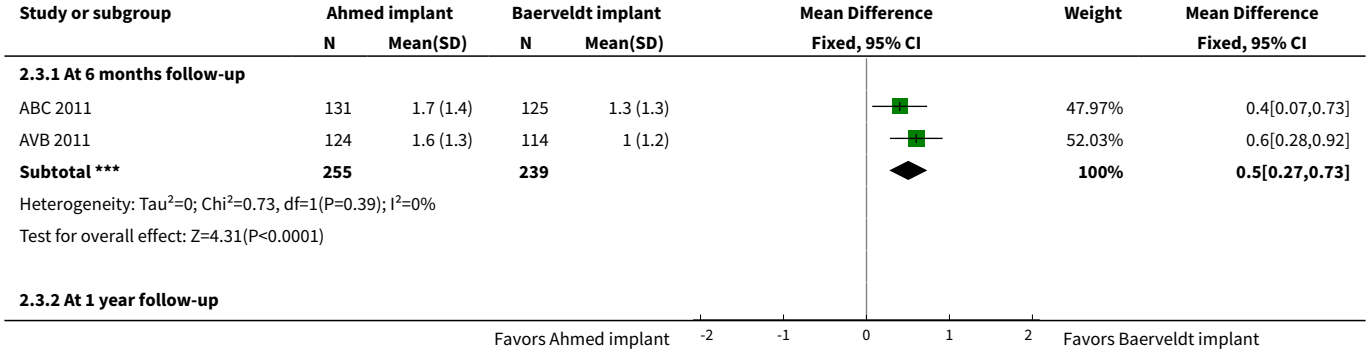
Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Baerveldt implant N	Baerveldt implant Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
ABC 2011	87	14.7 (4.4)	87	12.7 (4.5)		100%	2[0.68,3.32]
Subtotal ***	**87**		**87**			**100%**	**2[0.68,3.32]**
Heterogeneity: Not applicable							
Test for overall effect: Z=2.96(P=0)							
Test for subgroup differences: Chi^2=4.6, df=1 (P=0.2), I^2=34.84%							

Analysis 2.2. Comparison 2 Ahmed implant versus 350 mm² Baerveldt implant for glaucoma, Outcome 2 Mean logMAR visual acuity.

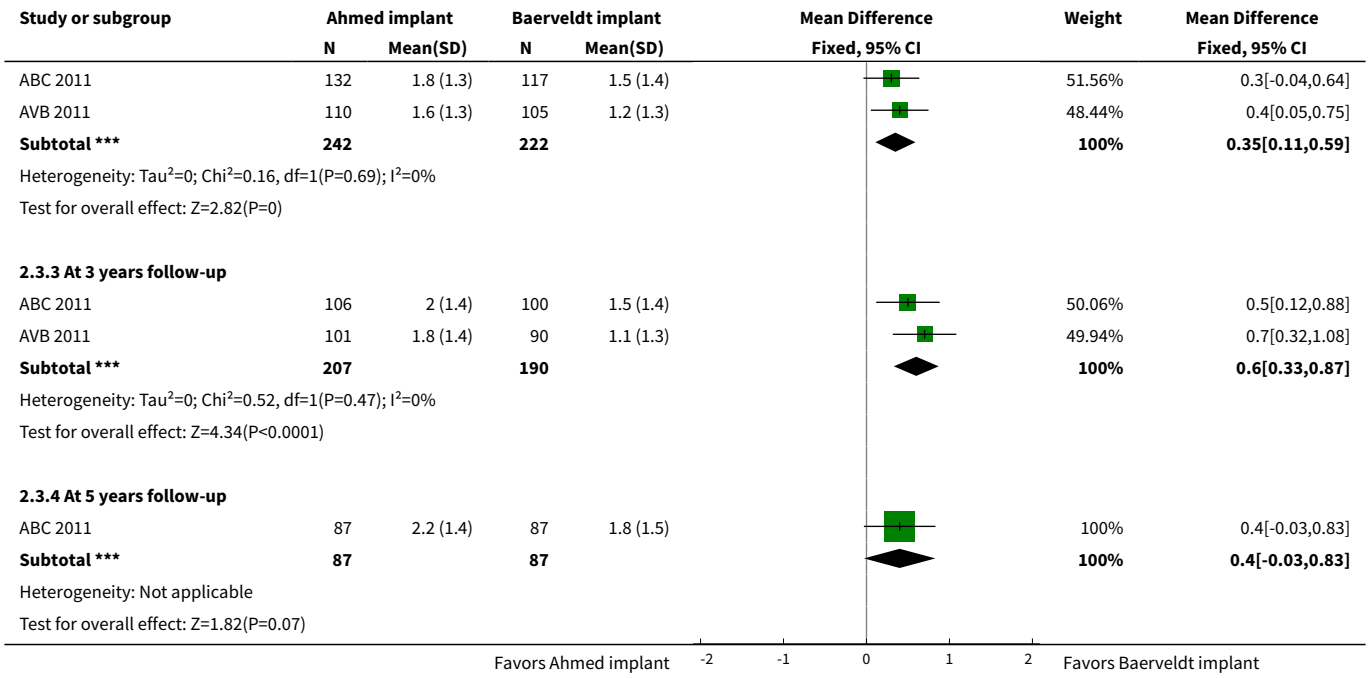


Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Baerveldt implant N	Baerveldt implant Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
2.2.1 At 1 year follow-up							
ABC 2011	143	1.2 (1.1)	143	1.2 (1.2)		57.98%	-0.05[-0.31,0.21]
AVB 2011	110	1.4 (1.1)	105	1.5 (1.2)		42.02%	-0.1[-0.41,0.21]
Subtotal ***	**253**		**248**			**100%**	**-0.07[-0.27,0.13]**
Heterogeneity: Tau^2=0; Chi^2=0.06, df=1(P=0.81); I^2=0%							
Test for overall effect: Z=0.7(P=0.49)							
2.2.2 At 3 years follow-up							
ABC 2011	104	1.2 (1.1)	101	1.2 (1.3)		52.63%	-0.03[-0.35,0.29]
AVB 2011	101	1.6 (1.2)	90	1.6 (1.2)		47.37%	0[-0.34,0.34]
Subtotal ***	**205**		**191**			**100%**	**-0.02[-0.25,0.22]**
Heterogeneity: Tau^2=0; Chi^2=0.02, df=1(P=0.9); I^2=0%							
Test for overall effect: Z=0.13(P=0.9)							
2.2.3 At 5 years follow-up							
ABC 2011	86	1.4 (1.2)	87	1.4 (1.4)		100%	-0.01[-0.39,0.37]
Subtotal ***	**86**		**87**			**100%**	**-0.01[-0.39,0.37]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.05(P=0.96)							

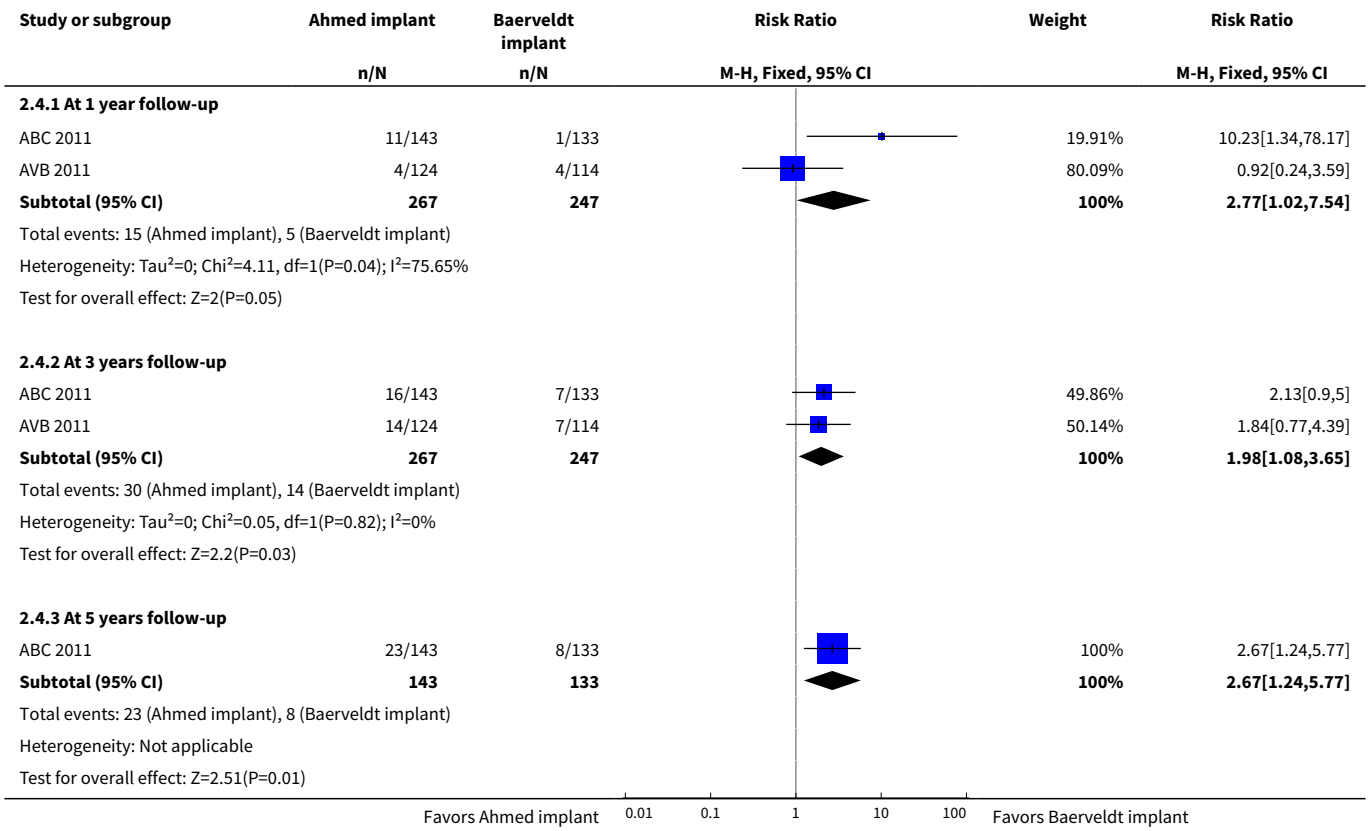
Analysis 2.3. Comparison 2 Ahmed implant versus 350 mm² Baerveldt implant for glaucoma, Outcome 3 Mean number of antiglaucoma medications.



Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Baerveldt implant N	Baerveldt implant Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
2.3.1 At 6 months follow-up							
ABC 2011	131	1.7 (1.4)	125	1.3 (1.3)		47.97%	0.4[0.07,0.73]
AVB 2011	124	1.6 (1.3)	114	1 (1.2)		52.03%	0.6[0.28,0.92]
Subtotal ***	**255**		**239**			**100%**	**0.5[0.27,0.73]**
Heterogeneity: Tau^2=0; Chi^2=0.73, df=1(P=0.39); I^2=0%							
Test for overall effect: Z=4.31(P<0.0001)							
2.3.2 At 1 year follow-up							

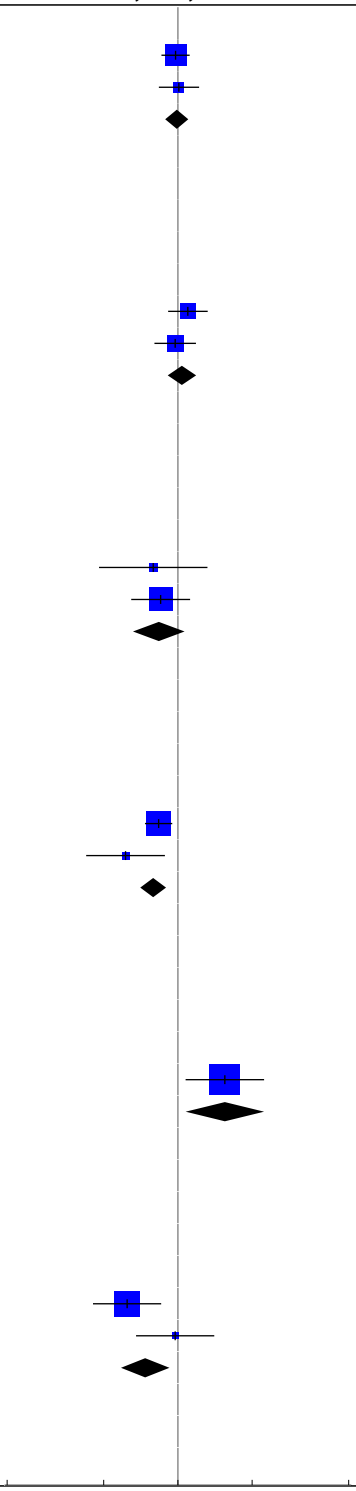


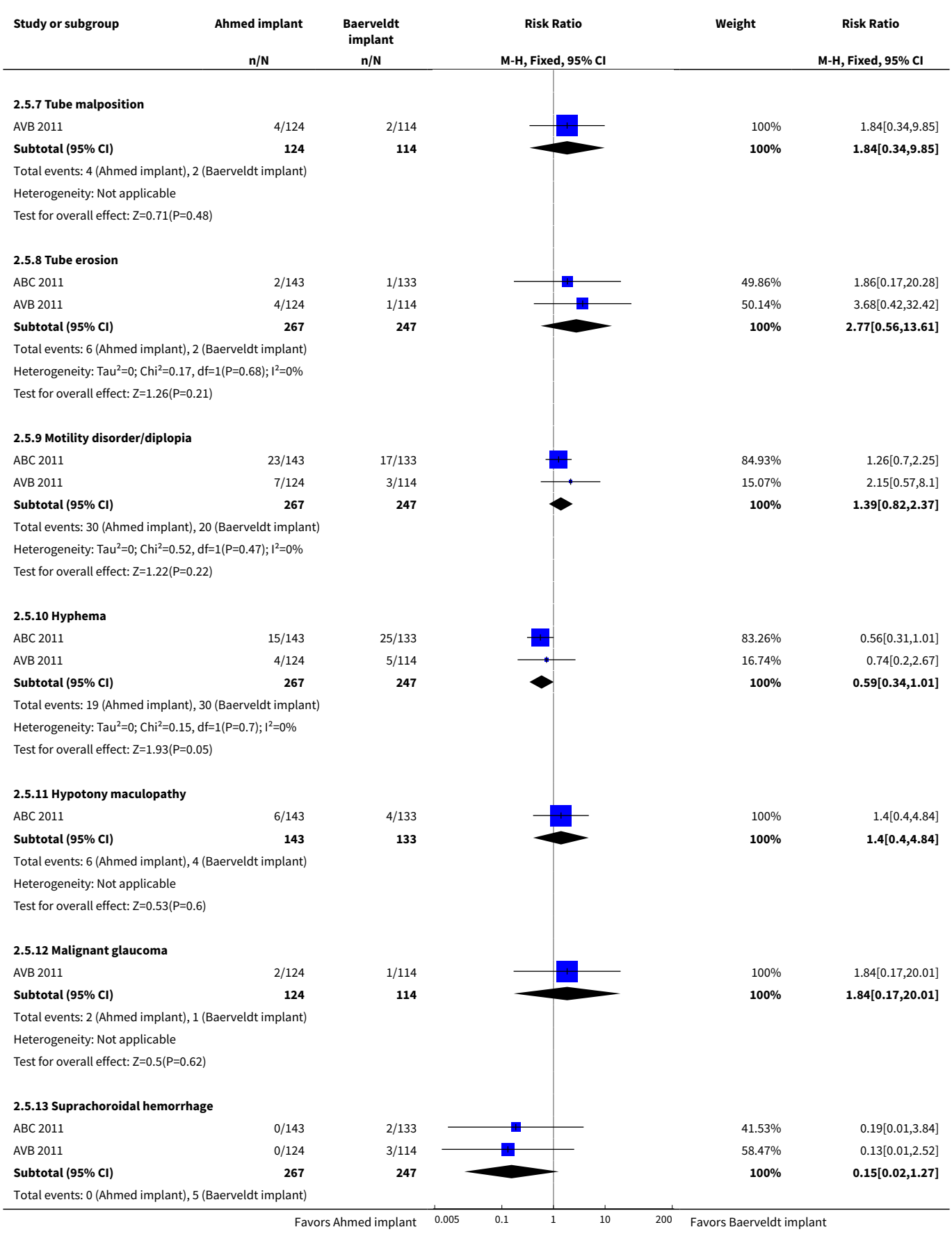
Analysis 2.4. Comparison 2 Ahmed implant versus 350 mm² Baerveldt implant for glaucoma, Outcome 4 Need for reoperation to control glaucoma progression.

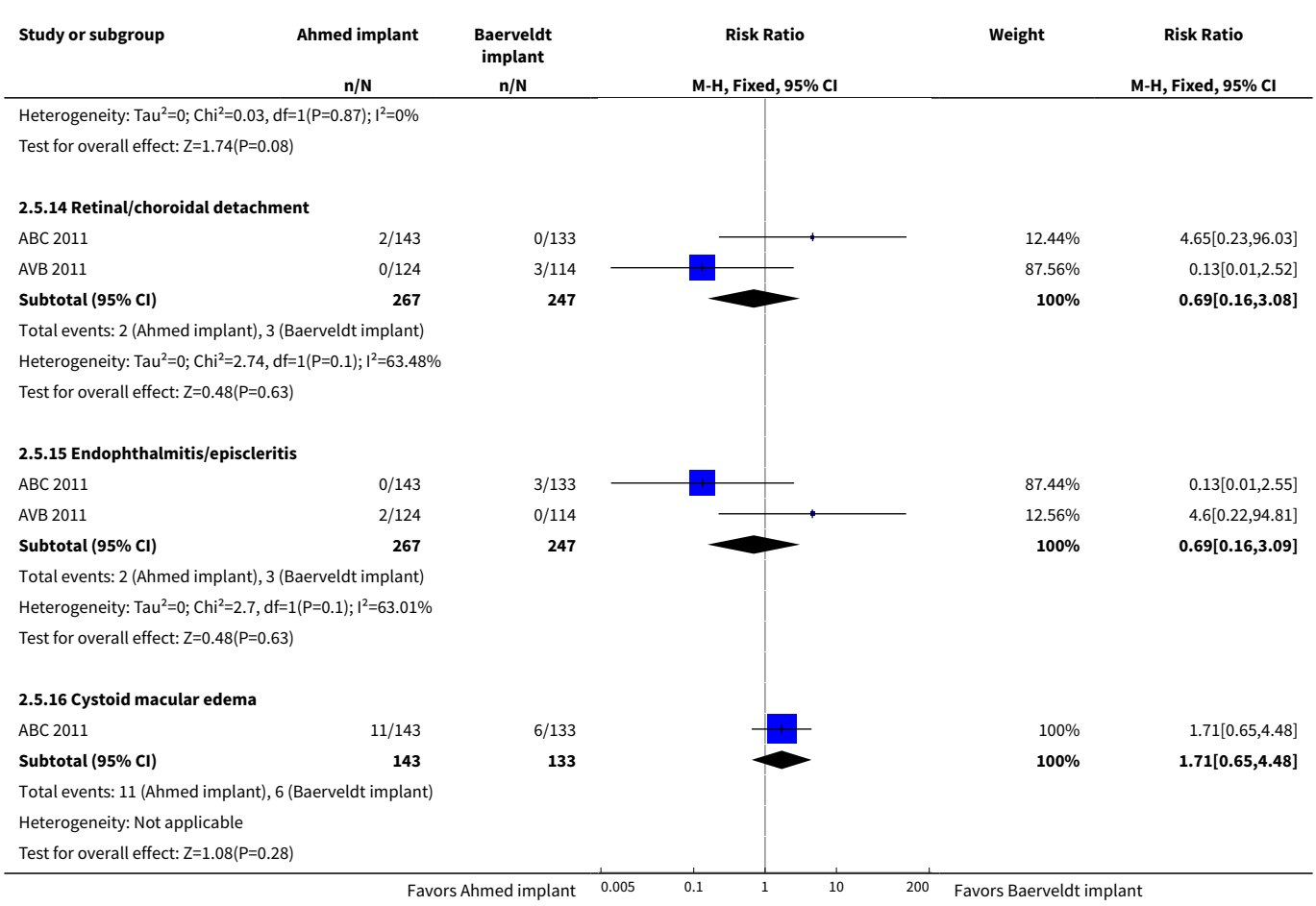


Analysis 2.5. Comparison 2 Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma, Outcome 5 Complications at 1 year follow-up.

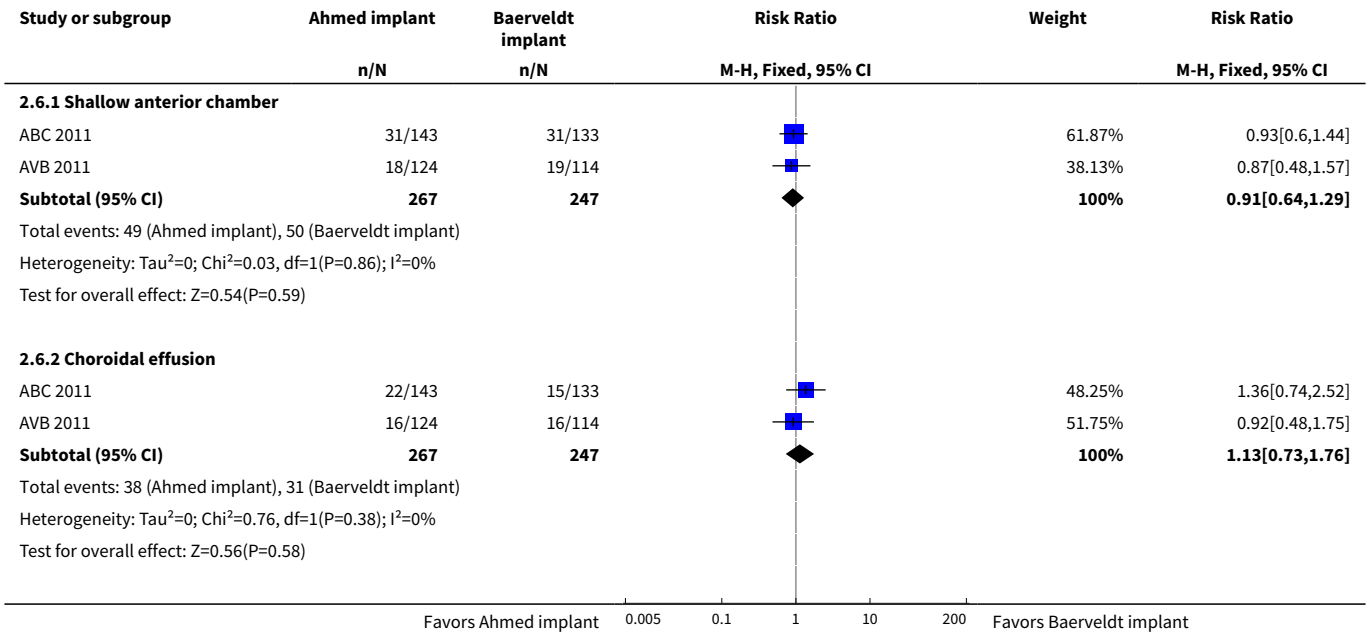
Study or subgroup	Ahmed implant n/N	Baerveldt implant n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
2.5.1 Shallow anterior chamber					
ABC 2011	31/143	31/133		65.83%	0.93[0.6,1.44]
AVB 2011	18/124	16/114		34.17%	1.03[0.55,1.93]
Subtotal (95% CI)	**267**	**247**		**100%**	**0.97[0.67,1.38]**
Total events: 49 (Ahmed implant), 47 (Baerveldt implant)					
Heterogeneity: Tau^2=0; Chi^2=0.07, df=1(P=0.78); I^2=0%					
Test for overall effect: Z=0.19(P=0.85)					
2.5.2 Choroidal effusion					
ABC 2011	22/143	15/133		48.25%	1.36[0.74,2.52]
AVB 2011	16/124	16/114		51.75%	0.92[0.48,1.75]
Subtotal (95% CI)	**267**	**247**		**100%**	**1.13[0.73,1.76]**
Total events: 38 (Ahmed implant), 31 (Baerveldt implant)					
Heterogeneity: Tau^2=0; Chi^2=0.76, df=1(P=0.38); I^2=0%					
Test for overall effect: Z=0.56(P=0.58)					
2.5.3 Iritis					
ABC 2011	2/143	4/133		26.56%	0.47[0.09,2.5]
AVB 2011	7/124	11/114		73.44%	0.59[0.23,1.46]
Subtotal (95% CI)	**267**	**247**		**100%**	**0.55[0.25,1.23]**
Total events: 9 (Ahmed implant), 15 (Baerveldt implant)					
Heterogeneity: Tau^2=0; Chi^2=0.06, df=1(P=0.81); I^2=0%					
Test for overall effect: Z=1.45(P=0.15)					
2.5.4 Corneal edema					
ABC 2011	26/143	44/133		75.76%	0.55[0.36,0.84]
AVB 2011	3/124	14/114		24.24%	0.2[0.06,0.67]
Subtotal (95% CI)	**267**	**247**		**100%**	**0.46[0.31,0.69]**
Total events: 29 (Ahmed implant), 58 (Baerveldt implant)					
Heterogeneity: Tau^2=0; Chi^2=2.5, df=1(P=0.11); I^2=60.08%					
Test for overall effect: Z=3.77(P=0)					
2.5.5 Encapsulated bleb					
AVB 2011	14/124	3/114		100%	4.29[1.27,14.54]
Subtotal (95% CI)	**124**	**114**		**100%**	**4.29[1.27,14.54]**
Total events: 14 (Ahmed implant), 3 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.34(P=0.02)					
2.5.6 Tube obstruction					
ABC 2011	4/143	18/133		78.17%	0.21[0.07,0.59]
AVB 2011	5/124	5/114		21.83%	0.92[0.27,3.09]
Subtotal (95% CI)	**267**	**247**		**100%**	**0.36[0.17,0.77]**
Total events: 9 (Ahmed implant), 23 (Baerveldt implant)					
Heterogeneity: Tau^2=0; Chi^2=3.35, df=1(P=0.07); I^2=70.11%					
Test for overall effect: Z=2.64(P=0.01)					

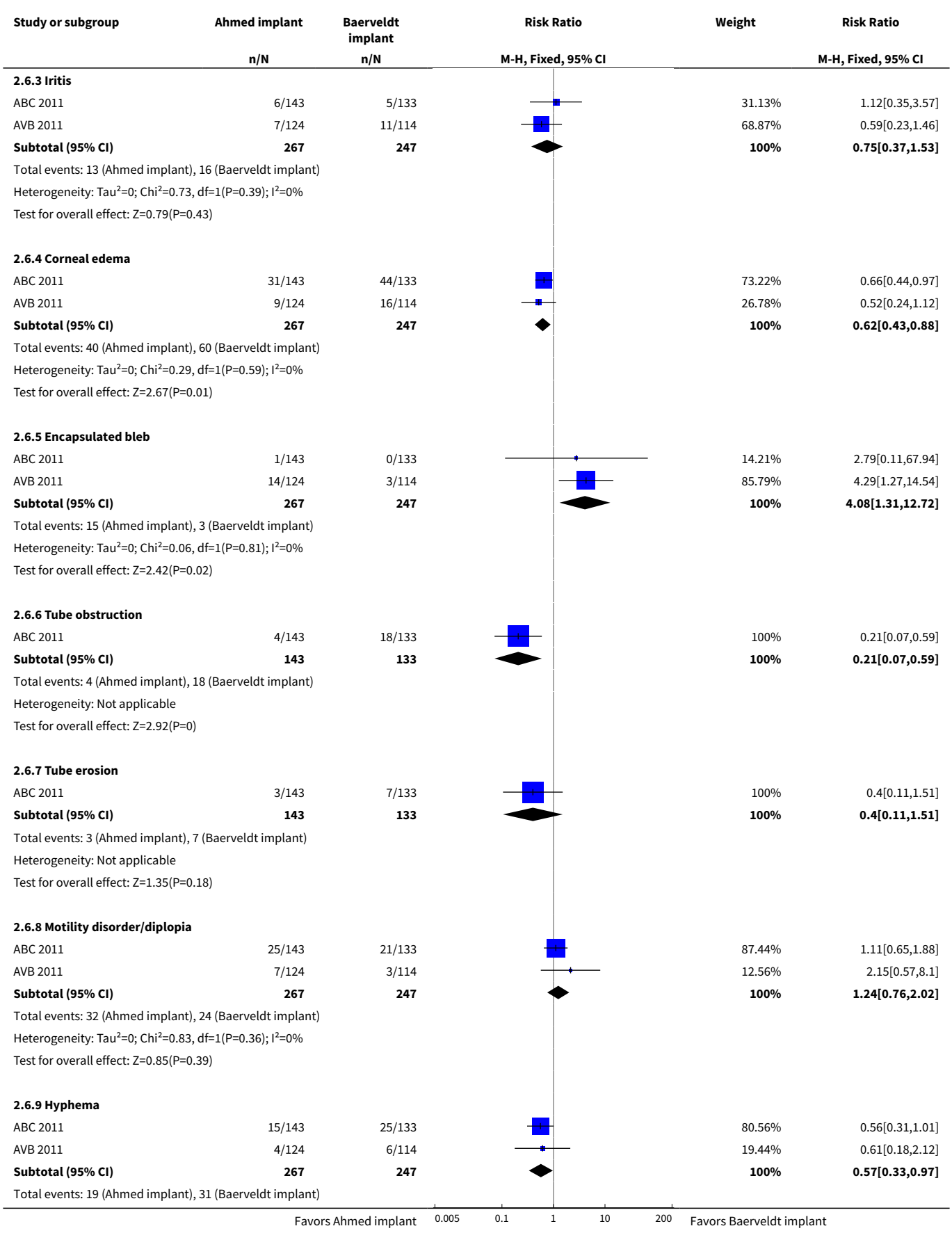


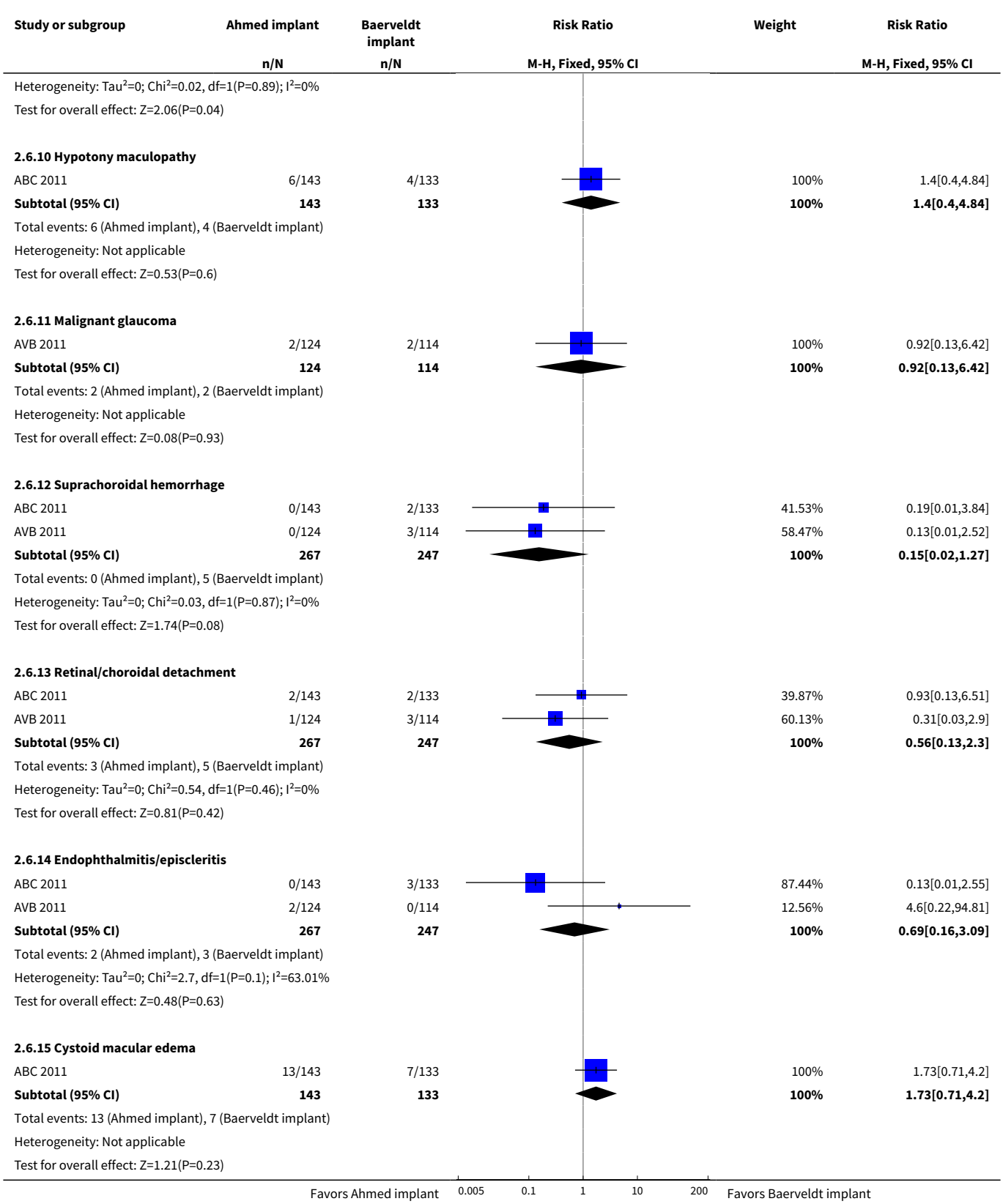




Analysis 2.6. Comparison 2 Ahmed implant versus 350 mm² Baerveldt implant for glaucoma, Outcome 6 Complications at 3 years follow-up.

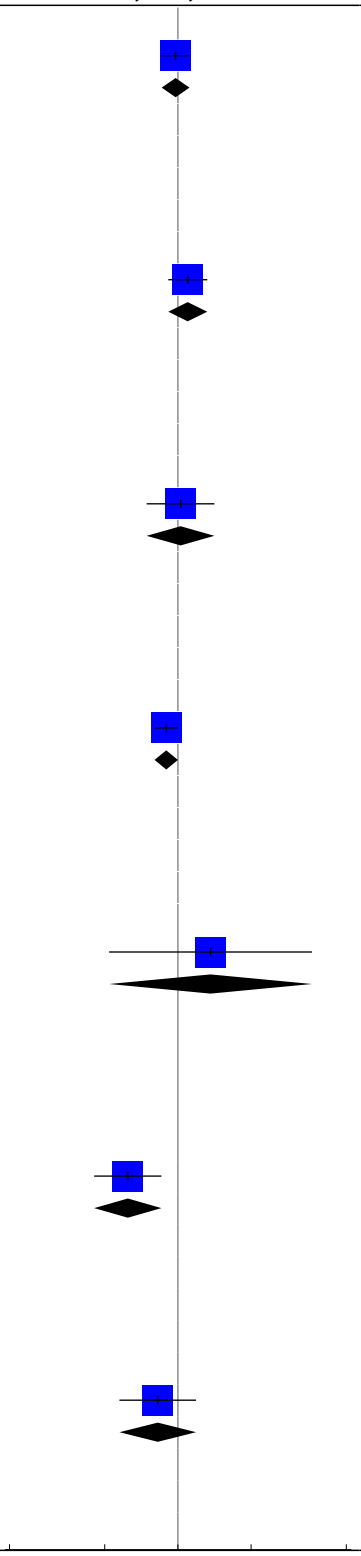


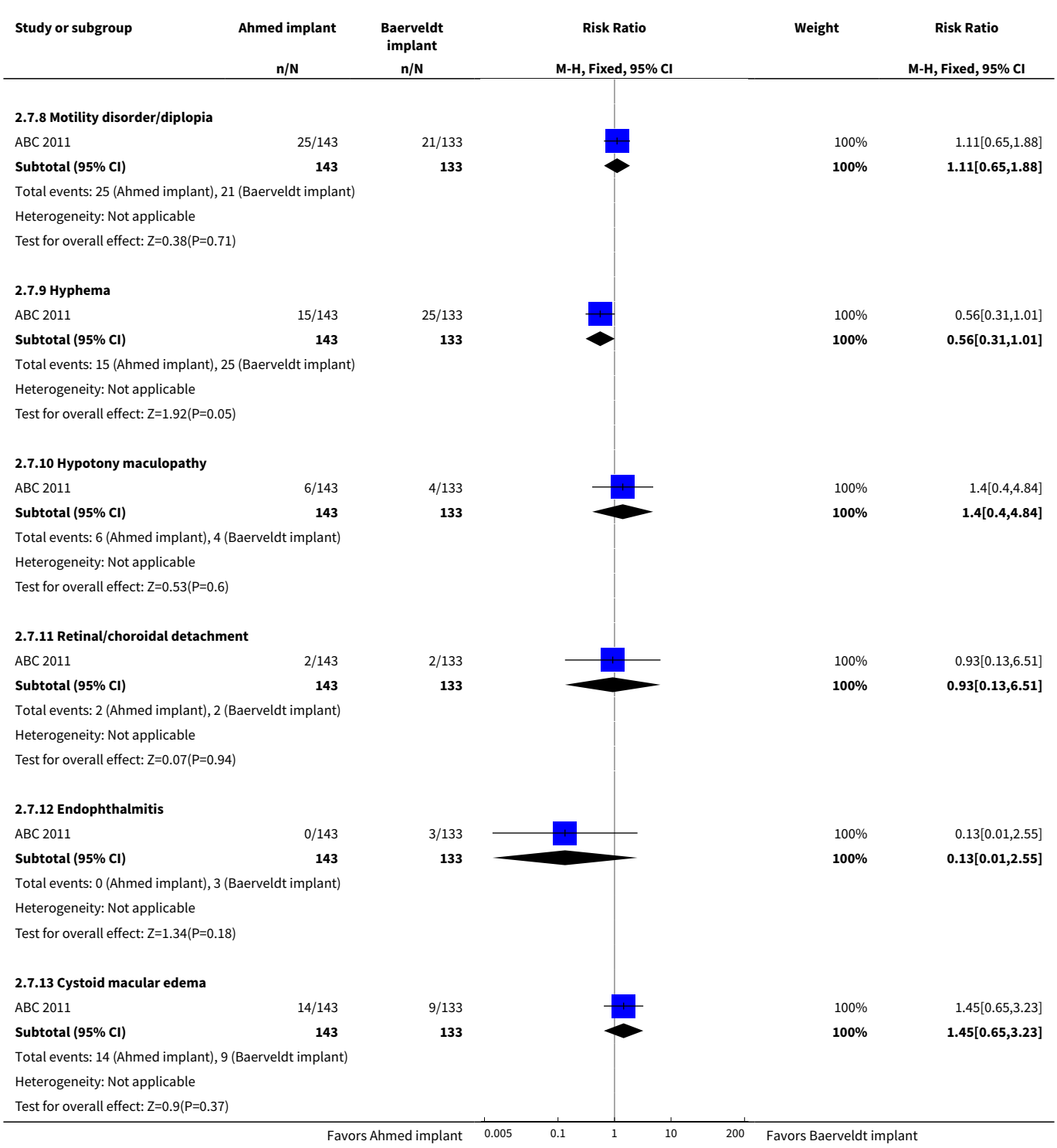




Analysis 2.7. Comparison 2 Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma, Outcome 7 Complications at 5 years follow-up.

Study or subgroup	Ahmed implant n/N	Baerveldt implant n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
2.7.1 Shallow anterior chamber					
ABC 2011	31/143	31/133		100%	0.93[0.6,1.44]
Subtotal (95% CI)	**143**	**133**		**100%**	**0.93[0.6,1.44]**
Total events: 31 (Ahmed implant), 31 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.32(P=0.75)					
2.7.2 Choroidal effusion					
ABC 2011	22/143	15/133		100%	1.36[0.74,2.52]
Subtotal (95% CI)	**143**	**133**		**100%**	**1.36[0.74,2.52]**
Total events: 22 (Ahmed implant), 15 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.99(P=0.32)					
2.7.3 Iritis					
ABC 2011	7/143	6/133		100%	1.09[0.37,3.15]
Subtotal (95% CI)	**143**	**133**		**100%**	**1.09[0.37,3.15]**
Total events: 7 (Ahmed implant), 6 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.15(P=0.88)					
2.7.4 Corneal edema					
ABC 2011	35/143	47/133		100%	0.69[0.48,1]
Subtotal (95% CI)	**143**	**133**		**100%**	**0.69[0.48,1]**
Total events: 35 (Ahmed implant), 47 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.95(P=0.05)					
2.7.5 Encapsulated bleb					
ABC 2011	1/143	0/133		100%	2.79[0.11,67.94]
Subtotal (95% CI)	**143**	**133**		**100%**	**2.79[0.11,67.94]**
Total events: 1 (Ahmed implant), 0 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.63(P=0.53)					
2.7.6 Tube obstruction					
ABC 2011	4/143	18/133		100%	0.21[0.07,0.59]
Subtotal (95% CI)	**143**	**133**		**100%**	**0.21[0.07,0.59]**
Total events: 4 (Ahmed implant), 18 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.92(P=0)					
2.7.7 Tube erosion					
ABC 2011	4/143	7/133		100%	0.53[0.16,1.77]
Subtotal (95% CI)	**143**	**133**		**100%**	**0.53[0.16,1.77]**
Total events: 4 (Ahmed implant), 7 (Baerveldt implant)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.03(P=0.3)					



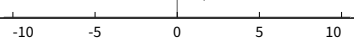


Comparison 3. Ahmed implant versus single-plate Molteno implant for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 2 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Intraocular pressure outcomes at 2 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Mean logMAR visual acuity at 2 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4 Visual field mean deviation at 2 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
5 Mean number of antiglaucoma medications at 2 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
6 Complications at 2 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
6.1 Hyphema >1mm	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.2 Wound dehiscence	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.3 Choroidal effusion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.4 Choroidal maculopathy	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.5 Flat anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.6 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.7 Tenon cyst	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.8 Cataract formation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

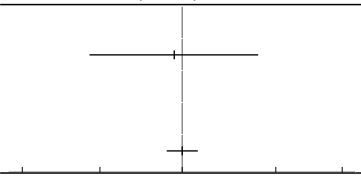
Analysis 3.1. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 1 Mean intraocular pressure at 2 years follow-up.

Study or subgroup	Ahmed implant		Molteno implant		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
Nassiri 2010	29	17 (1.2)	28	15.4 (1.8)		1.64[0.85,2.43]



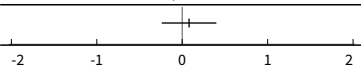
Analysis 3.2. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 2 Intraocular pressure outcomes at 2 years follow-up.

Study or subgroup	Ahmed implant n/N	Molteno implant n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
3.2.1 Complete success				
Nassiri 2010	19/29	19/28		0.97[0.67,1.39]
3.2.2 Qualified or complete success				
Nassiri 2010	29/29	28/28		1[0.94,1.07]



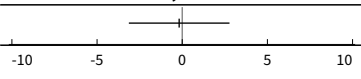
Analysis 3.3. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 3 Mean logMAR visual acuity at 2 years follow-up.

Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Molteno implant N	Molteno implant Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Nassiri 2010	29	0.8 (0.7)	28	0.7 (0.6)		0.08[-0.24,0.4]



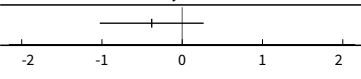
Analysis 3.4. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 4 Visual field mean deviation at 2 years follow-up.

Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Molteno implant N	Molteno implant Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Nassiri 2010	29	-19.7 (5.1)	28	-19.5 (6.2)		-0.18[-3.13,2.77]



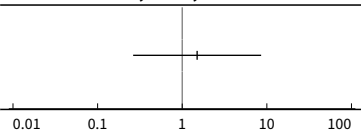
Analysis 3.5. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 5 Mean number of antiglaucoma medications at 2 years follow-up.

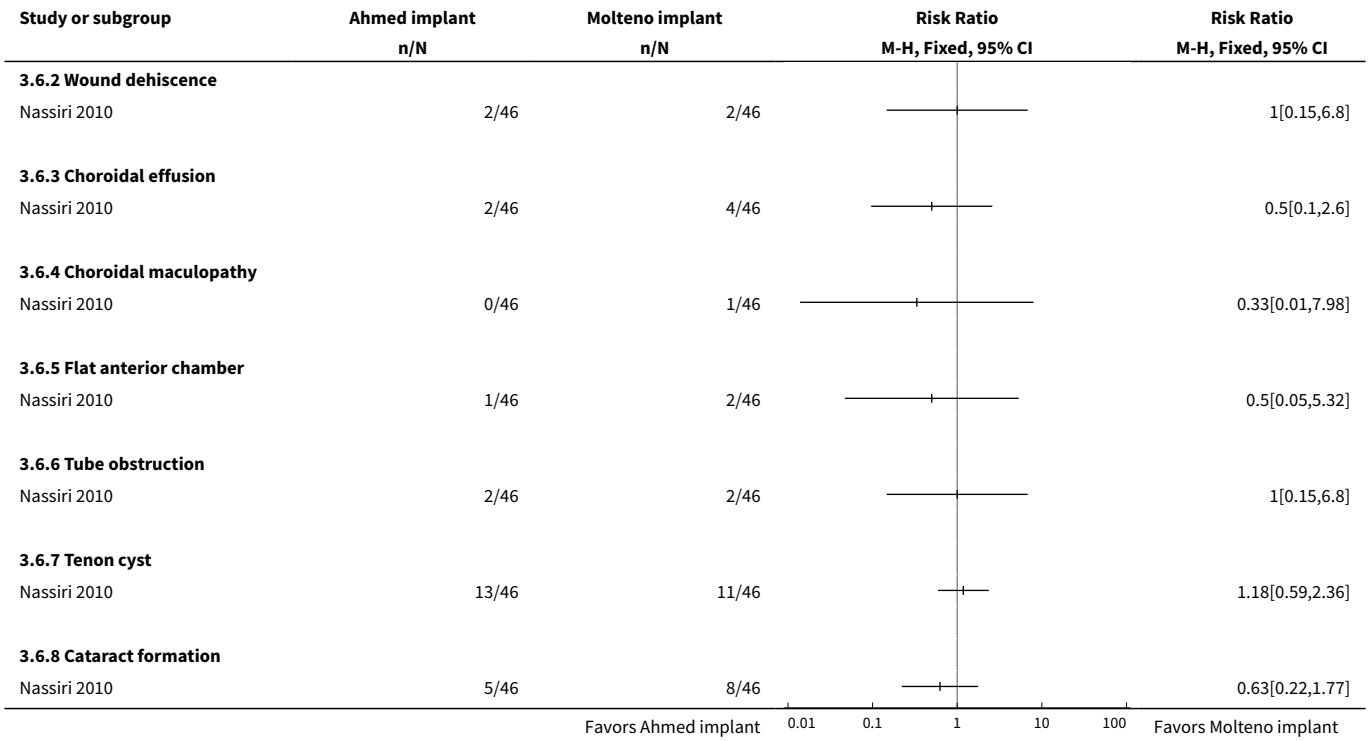
Study or subgroup	Ahmed implant N	Ahmed implant Mean(SD)	Molteno implant N	Molteno implant Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Nassiri 2010	29	1 (1.5)	28	1.4 (1)		-0.38[-1.03,0.27]



Analysis 3.6. Comparison 3 Ahmed implant versus single-plate Molteno implant for glaucoma, Outcome 6 Complications at 2 years follow-up.

Study or subgroup	Ahmed implant n/N	Molteno implant n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
3.6.1 Hyphema >1mm				
Nassiri 2010	3/46	2/46		1.5[0.26,8.56]



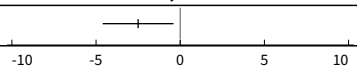


Comparison 4. Double-plate Molteno implant versus Schocket shunt for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Complications at 6 to 12 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Choroidal detachment with shallow anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.3 Chronic uveitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.4 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.5 Sterile endophthalmitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.6 Chronic hypotony	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.7 Suprachoroidal hemorrhage	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.8 Malignant glaucoma	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

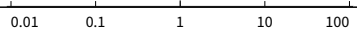
Analysis 4.1. Comparison 4 Double-plate Molteno implant versus Schocket shunt for glaucoma, Outcome 1 Mean intraocular pressure at 6 months follow-up.

Study or subgroup	Molteno implant N	Molteno implant Mean(SD)	Schocket shunt N	Schocket shunt Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Wilson 1992	63	16.4 (6.2)	52	18.9 (5.3)		-2.5[-4.6,-0.4]



Analysis 4.2. Comparison 4 Double-plate Molteno implant versus Schocket shunt for glaucoma, Outcome 2 Complications at 6 to 12 months follow-up.

Study or subgroup	Molteno implant n/N	Schocket shunt n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
4.2.1 Choroidal detachment with shallow anterior chamber				
Wilson 1992	13/65	11/53		0.96[0.47,1.97]
4.2.2 Tube obstruction				
Wilson 1992	4/65	1/53		3.26[0.38,28.31]
4.2.3 Chronic uveitis				
Wilson 1992	2/65	1/53		1.63[0.15,17.5]
4.2.4 Hyphema				
Wilson 1992	1/65	2/53		0.41[0.04,4.37]
4.2.5 Sterile endophthalmitis				
Wilson 1992	1/65	0/53		2.45[0.1,59.04]
4.2.6 Chronic hypotony				
Wilson 1992	1/65	0/53		2.45[0.1,59.04]
4.2.7 Suprachoroidal hemorrhage				
Wilson 1992	1/65	1/53		0.82[0.05,12.73]
4.2.8 Malignant glaucoma				
Wilson 1992	1/65	0/53		2.45[0.1,59.04]



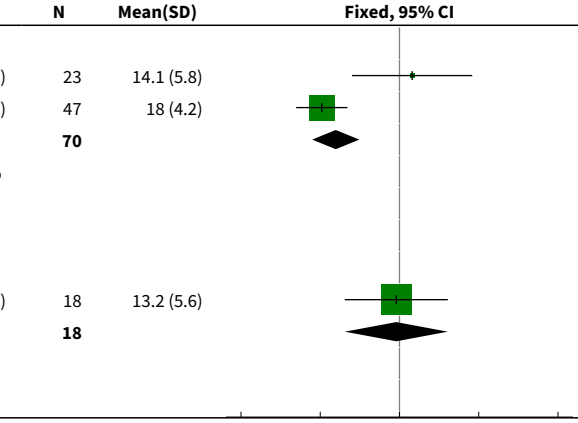
Comparison 5. Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 At 6 months follow-up	2	141	Mean Difference (IV, Fixed, 95% CI)	-4.02 [-5.51, -2.53]
1.2 At 1 year follow-up	1	39	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-3.45, 3.05]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2 Mean logMAR visual acuity	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.1 At 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Mean antiglaucoma medications	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 At 6 months follow-up	2	141	Mean Difference (IV, Fixed, 95% CI)	0.30 [-0.02, 0.63]
3.2 At 1 year follow-up	1	39	Mean Difference (IV, Fixed, 95% CI)	0.0 [-0.56, 0.56]

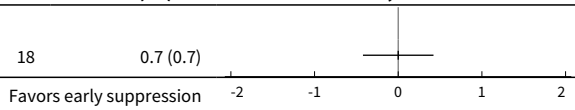
Analysis 5.1. Comparison 5 Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma, Outcome 1 Mean intraocular pressure.

Study or subgroup	Early aqueous suppression N	Mean(SD)	Standard regimen N	Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
5.1.1 At 6 months follow-up							
Law 2016	24	14.9 (7.4)	23	14.1 (5.8)		15.42%	0.8[-2.99,4.59]
Pakravan 2014	47	13.1 (3.8)	47	18 (4.2)		84.58%	-4.9[-6.52,-3.28]
Subtotal ***	**71**		**70**			**100%**	**-4.02[-5.51,-2.53]**
Heterogeneity: Tau^2=0; Chi^2=7.34, df=1(P=0.01); I^2=86.37%							
Test for overall effect: Z=5.29(P<0.0001)							
5.1.2 At 1 year follow-up							
Law 2016	21	13 (4.6)	18	13.2 (5.6)		100%	-0.2[-3.45,3.05]
Subtotal ***	**21**		**18**			**100%**	**-0.2[-3.45,3.05]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.12(P=0.9)							



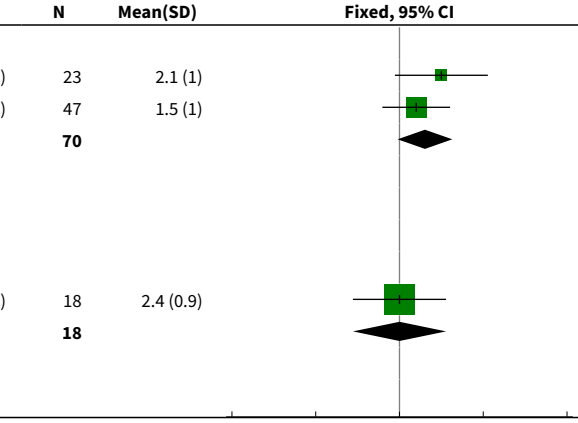
Analysis 5.2. Comparison 5 Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma, Outcome 2 Mean logMAR visual acuity.

Study or subgroup	Early aqueous suppression N	Mean(SD)	Standard regimen N	Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
5.2.1 At 1 year follow-up						
Law 2016	21	0.7 (0.7)	18	0.7 (0.7)		0[-0.42,0.42]



Analysis 5.3. Comparison 5 Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma, Outcome 3 Mean antiglaucoma medications.

Study or subgroup	Early aqueous suppression N	Mean(SD)	Standard regimen N	Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
5.3.1 At 6 months follow-up							
Law 2016	24	2.6 (1)	23	2.1 (1)		34.7%	0.5[-0.05,1.05]
Pakravan 2014	47	1.7 (1)	47	1.5 (1)		65.3%	0.2[-0.2,0.6]
Subtotal ***	**71**		**70**			**100%**	**0.3[-0.02,0.63]**
Heterogeneity: Tau^2=0; Chi^2=0.73, df=1(P=0.39); I^2=0%							
Test for overall effect: Z=1.82(P=0.07)							
5.3.2 At 1 year follow-up							
Law 2016	21	2.4 (0.9)	18	2.4 (0.9)		100%	0[-0.56,0.56]
Subtotal ***	**21**		**18**			**100%**	**0[-0.56,0.56]**
Heterogeneity: Not applicable							
Test for overall effect: Not applicable							

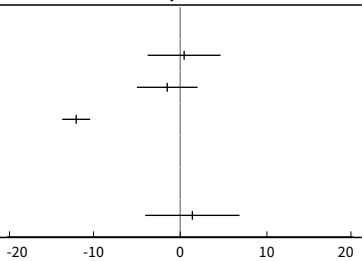


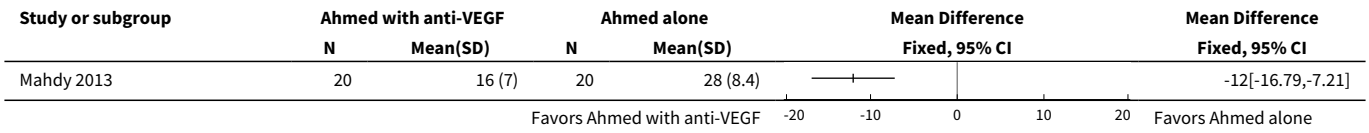
Comparison 6. Ahmed implant with anti-VEGF versus Ahmed implant alone for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	3		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.1 At 6 months follow-up	3		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 At 1 year follow-up	2		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2 Mean antiglaucoma medications	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 At 6 months follow-up	2	44	Mean Difference (IV, Fixed, 95% CI)	0.00 [-0.63, 0.64]
2.2 At 1 year follow-up	1	30	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.65, 0.71]

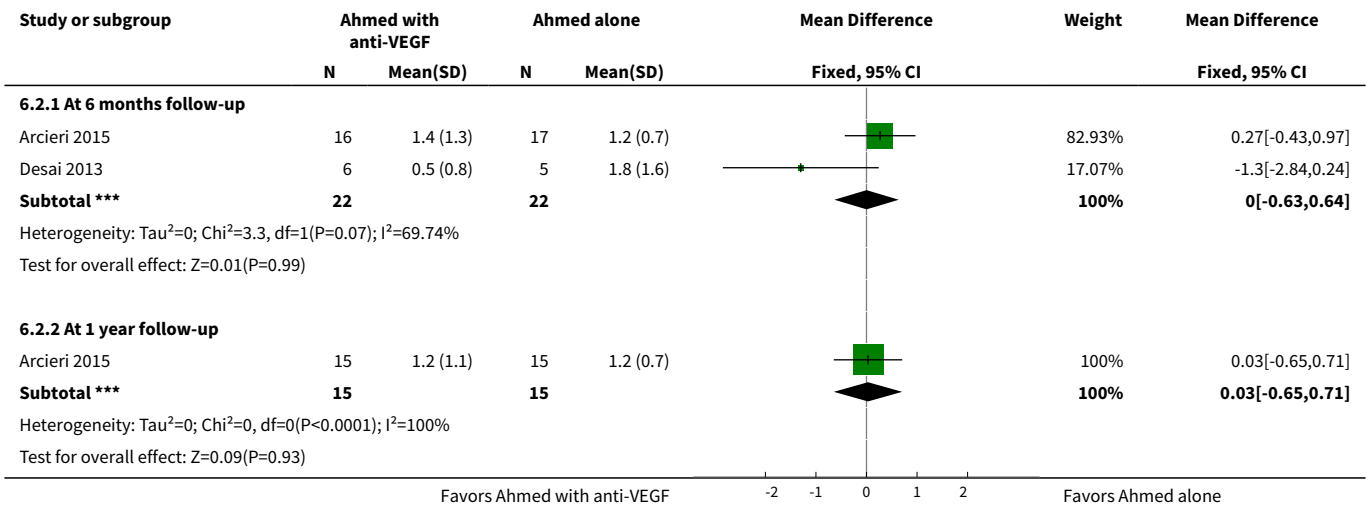
Analysis 6.1. Comparison 6 Ahmed implant with anti-VEGF versus Ahmed implant alone for glaucoma, Outcome 1 Mean intraocular pressure.

Study or subgroup	Ahmed with anti-VEGF N	Mean(SD)	Ahmed alone N	Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
6.1.1 At 6 months follow-up						
Arcieri 2015	16	16.8 (7.5)	17	16.3 (4.4)		0.45[-3.75,4.65]
Desai 2013	6	14.7 (1.9)	5	16.2 (3.6)		-1.5[-5,2]
Mahdy 2013	20	16 (2)	20	28 (3.1)		-12[-13.62,-10.38]
6.1.2 At 1 year follow-up						
Arcieri 2015	15	17.4 (10)	15	16 (4)		1.4[-4.04,6.84]





Analysis 6.2. Comparison 6 Ahmed implant with anti-VEGF versus Ahmed implant alone for glaucoma, Outcome 2 Mean antiglaucoma medications.



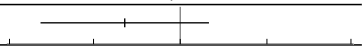
Comparison 7. Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Complete success at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3 Mean antiglaucoma medications at 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
4 Complications at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4.1 Loss of light perception	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Phthisis bulbi	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.3 Corneal decompensation	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.4 Hemorrhagic choroidal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.5 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.6 Serous choroidal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.7 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.8 Aqueous misdirection	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 7.1. Comparison 7 Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma, Outcome 1 Mean intraocular pressure at 1 year follow-up.

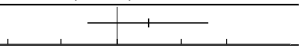
Study or subgroup	IV triamcinolone		No triamcinolone		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
Teixeira 2012	18	13.9 (3.7)	25	15.5 (4.4)		-1.6[-4.03,0.83]



Favors IV triamcinolone — Favors no triamcinolone

Analysis 7.2. Comparison 7 Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma, Outcome 2 Complete success at 1 year follow-up.

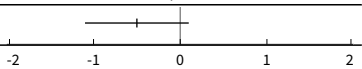
Study or subgroup	IV triamcinolone	No triamcinolone	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Teixeira 2012	14/18	16/25		1.22[0.83,1.78]



Favors no triamcinolone — Favors IV triamcinolone

Analysis 7.3. Comparison 7 Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma, Outcome 3 Mean antiglaucoma medications at 1 year follow-up.

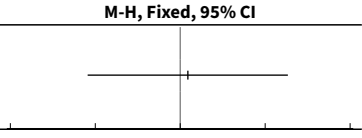
Study or subgroup	IV triamcinolone		No triamcinolone		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
Teixeira 2012	18	0.8 (0.8)	25	1.3 (1.2)		-0.5[-1.1,0.1]



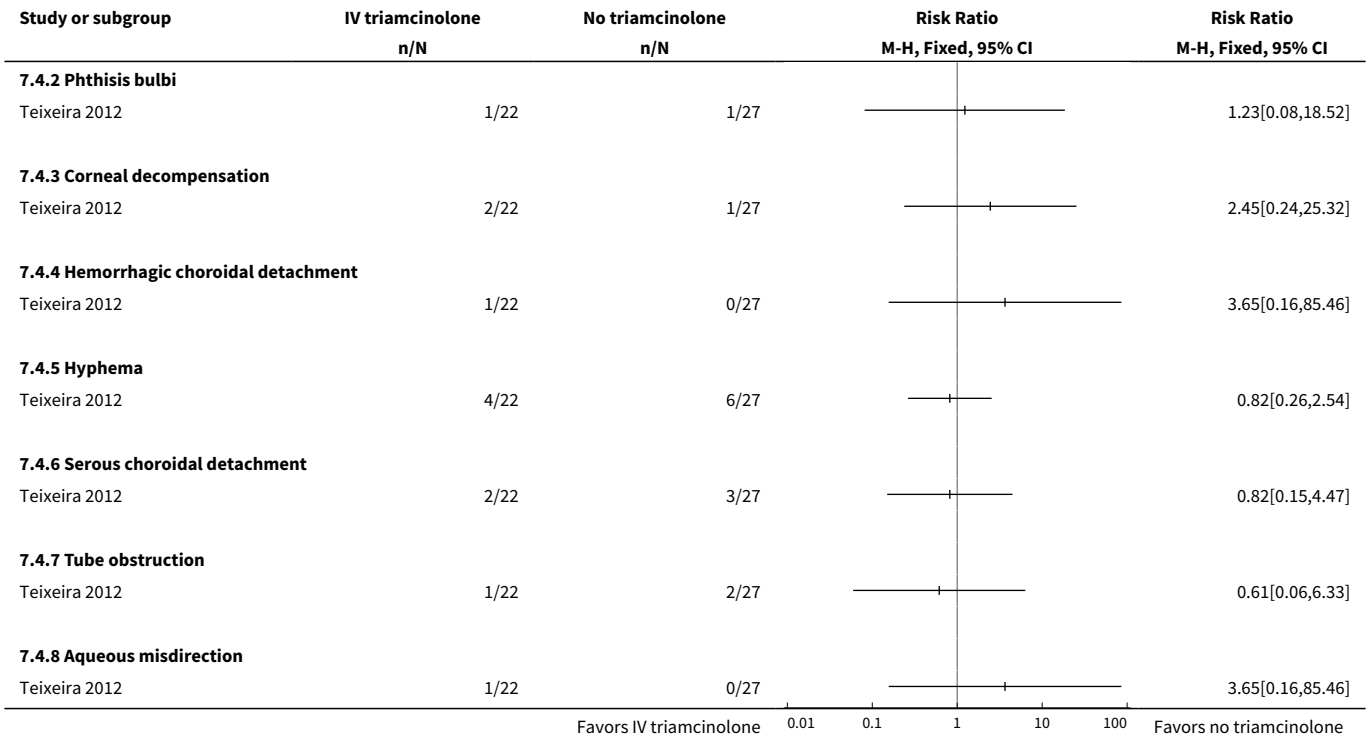
Favors IV triamcinolone — Favors no triamcinolone

Analysis 7.4. Comparison 7 Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma, Outcome 4 Complications at 1 year follow-up.

Study or subgroup	IV triamcinolone	No triamcinolone	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
7.4.1 Loss of light perception				
Teixeira 2012	1/22	1/27		1.23[0.08,18.52]



Favors IV triamcinolone — Favors no triamcinolone



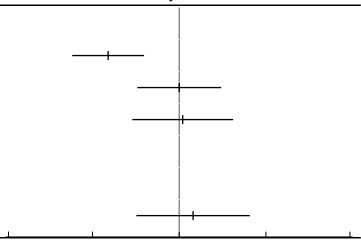
Comparison 8. Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	3		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.1 At 6 months follow-up	3		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 At 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2 Intraocular pressure outcomes at 6 months follow-up	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
2.1 Complete success	2	63	Risk Ratio (M-H, Fixed, 95% CI)	1.50 [0.88, 2.55]
2.2 Qualified or complete success	2	63	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.88, 1.19]
3 Intraocular pressure outcomes at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4 Postoperative hypertensive phase	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5 Mean antiglaucoma medications at 6 months follow-up	2		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
6 Complications at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
6.1 Early hypotony	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.2 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.3 Choroidal effusion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.4 Tube exposure	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.5 Endophthalmitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.6 Wound leak	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7 Complications at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
7.1 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.2 Choroidal effusion	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.3 Tube exposure	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.4 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
7.5 Malignant glaucoma	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

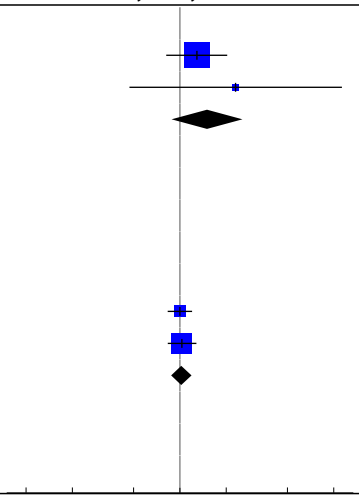
Analysis 8.1. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 1 Mean intraocular pressure.

Study or subgroup	Augmentation		No augmentation		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
8.1.1 At 6 months follow-up						
Hwang 2004	10	15.2 (2.1)	10	19.3 (2.6)		-4.1[-6.17,-2.03]
Rho 2015	22	14 (3.5)	21	14 (4.5)		0[-2.42,2.42]
Yazdani 2016	20	17 (4.9)	23	16.8 (4.8)		0.2[-2.71,3.11]
8.1.2 At 1 year follow-up						
Yazdani 2016	20	16.6 (6.3)	23	15.8 (4.3)		0.8[-2.47,4.07]



Analysis 8.2. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 2 Intraocular pressure outcomes at 6 months follow-up.

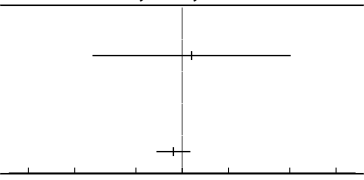
Study or subgroup	Augmentation n/N	No augmentation n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
8.2.1 Complete success					
Hwang 2004	9/10	7/10		79%	1.29[0.82,2.03]
Yazdani 2016	4/20	2/23		21%	2.3[0.47,11.26]
Subtotal (95% CI)	**30**	**33**		**100%**	**1.5[0.88,2.55]**
Total events: 13 (Augmentation), 9 (No augmentation)					
Heterogeneity: Tau^2=0; Chi^2=0.71, df=1(P=0.4); I^2=0%					
Test for overall effect: Z=1.49(P=0.14)					
8.2.2 Qualified or complete success					
Hwang 2004	10/10	10/10		36.08%	1[0.83,1.2]
Yazdani 2016	18/20	20/23		63.92%	1.03[0.83,1.28]
Subtotal (95% CI)	**30**	**33**		**100%**	**1.02[0.88,1.19]**
Total events: 28 (Augmentation), 30 (No augmentation)					
Heterogeneity: Tau^2=0; Chi^2=0.07, df=1(P=0.79); I^2=0%					
Test for overall effect: Z=0.28(P=0.78)					



Favors no augmentation — Favors augmentation

Analysis 8.3. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 3 Intraocular pressure outcomes at 1 year follow-up.

Study or subgroup	Augmentation n/N	No augmentation n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
8.3.1 Complete success				
Yazdani 2016	3/20	3/23		1.15[0.26,5.07]
8.3.2 Qualified or complete success				
Yazdani 2016	16/20	21/23		0.88[0.68,1.13]



Favors no augmentation — Favors augmentation

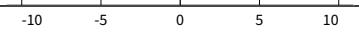
Analysis 8.4. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 4 Postoperative hypertensive phase.

Study or subgroup	Augmentation n/N	No augmentation n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Hwang 2004	2/10	8/10		0.25[0.07,0.9]

Favors augmentation — Favors no augmentation

Analysis 8.5. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 5 Mean antiglaucoma medications at 6 months follow-up.

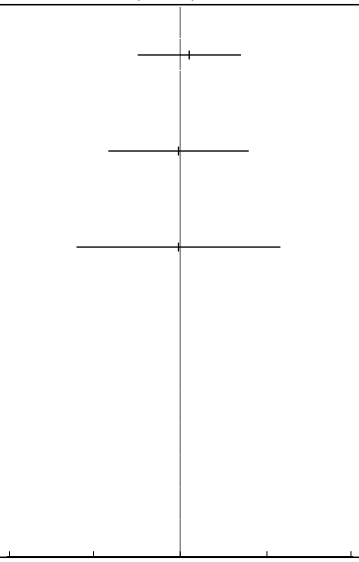
Study or subgroup	Augmentation		No augmentation		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
Hwang 2004	10	0.4 (0.7)	10	0.1 (0.3)		0.3[-0.17,0.77]
Rho 2015	22	0.2 (0.6)	22	1.3 (1.2)		-1.1[-1.66,-0.54]



Favors augmentation — Favors no augmentation

Analysis 8.6. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 6 Complications at 6 months follow-up.

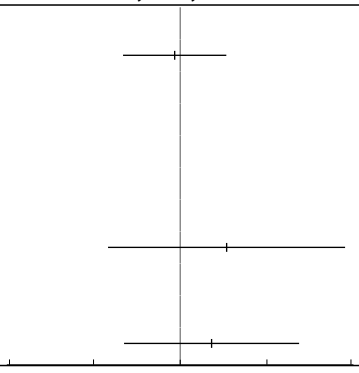
Study or subgroup	Augmentation	No augmentation	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
8.6.1 Early hypotony				
Rho 2015	4/22	3/21		1.27[0.32,5.02]
8.6.2 Hyphema				
Rho 2015	2/22	2/21		0.95[0.15,6.17]
8.6.3 Choroidal effusion				
Rho 2015	1/22	1/21		0.95[0.06,14.3]
8.6.4 Tube exposure				
Rho 2015	0/22	0/21		Not estimable
8.6.5 Endophthalmitis				
Rho 2015	0/22	0/21		Not estimable
8.6.6 Wound leak				
Rho 2015	0/22	0/21		Not estimable



Favors augmentation — Favors no augmentation

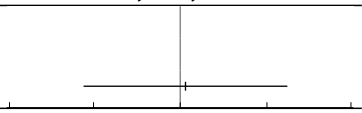
Analysis 8.7. Comparison 8 Ahmed implant with shunt augmentation versus Ahmed implant without shunt augmentation for glaucoma, Outcome 7 Complications at 1 year follow-up.

Study or subgroup	Augmentation	No augmentation	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
8.7.1 Hyphema				
Yazdani 2016	3/20	4/23		0.86[0.22,3.4]
8.7.2 Choroidal effusion				
Yazdani 2016	0/20	0/23		Not estimable
8.7.3 Tube exposure				
Yazdani 2016	1/20	0/23		3.43[0.15,79.74]
8.7.4 Tube obstruction				
Yazdani 2016	2/20	1/23		2.3[0.23,23.51]



Favors augmentation — Favors no augmentation

Study or subgroup	Augmentation n/N	No augmentation n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
8.7.5 Malignant glaucoma				
Yazdani 2016	1/20	1/23		1.15[0.08,17.22]

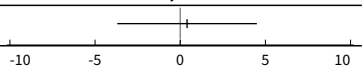


Comparison 9. Ahmed implant with partial tube ligation versus Ahmed implant with no ligation for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Intraocular pressure outcomes at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Complications at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Shallow anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Hypotony	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Choroidal effusion/detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.5 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

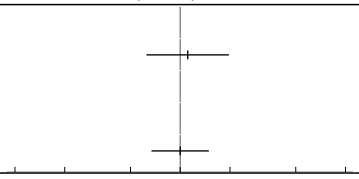
Analysis 9.1. Comparison 9 Ahmed implant with partial tube ligation versus Ahmed implant with no ligation for glaucoma, Outcome 1 Mean intraocular pressure at 6 months follow-up.

Study or subgroup	Ahmed with ligation N	Ahmed with ligation Mean(SD)	Ahmed without ligation N	Ahmed without ligation Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Kee 2001	16	19.6 (5.5)	16	19.2 (6.3)		0.4[-3.7,4.5]



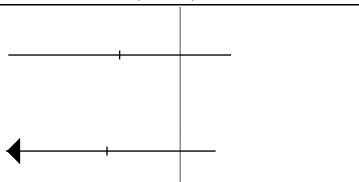
Analysis 9.2. Comparison 9 Ahmed implant with partial tube ligation versus Ahmed implant with no ligation for glaucoma, Outcome 2 Intraocular pressure outcomes at 6 months follow-up.

Study or subgroup	Ahmed with ligation n/N	Ahmed without ligation n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
9.2.1 Complete success				
Kee 2001	10/16	9/16		1.11[0.63,1.97]
9.2.2 Qualified or complete success				
Kee 2001	12/16	12/16		1[0.67,1.49]



Analysis 9.3. Comparison 9 Ahmed implant with partial tube ligation versus Ahmed implant with no ligation for glaucoma, Outcome 3 Complications at 6 months follow-up.

Study or subgroup	Ahmed with ligation n/N	Ahmed without ligation n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
9.3.1 Hyphema				
Kee 2001	0/16	2/16		0.2[0.01,3.86]
9.3.2 Shallow anterior chamber				
Kee 2001	0/16	3/16		0.14[0.01,2.56]
9.3.3 Hypotony				
Kee 2001	1/16	4/16		0.25[0.03,2]
9.3.4 Choroidal effusion/detachment				
Kee 2001	0/16	2/16		0.2[0.01,3.86]
9.3.5 Tube obstruction				
Kee 2001	1/16	1/16		1[0.07,14.64]



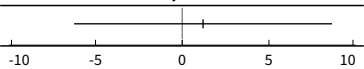
Comparison 10. Pars plana versus conventional Ahmed implant for glaucoma with penetrating keratoplasty

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 2 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Intraocular pressure outcomes at 2 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 Complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 Qualified or complete success	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Visual acuity improvement of 2 lines or more on Snellen chart at 2 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4 Complications at 2 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4.1 Tube-graft touch	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.2 Shallow anterior chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.3 Choroidal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.4 Vitreous hemorrhage	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.5 Tube exposure	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
4.6 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 10.1. Comparison 10 Pars plana versus conventional Ahmed implant for glaucoma with penetrating keratoplasty, Outcome 1 Mean intraocular pressure at 2 years follow-up.

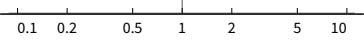
Study or subgroup	Pars plana Ahmed N	Pars plana Ahmed Mean(SD)	Conventional Ahmed N	Conventional Ahmed Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Parihar 2016	25	21.7 (13.9)	25	20.5 (12.9)		1.2[-6.23,8.63]



Favors pars plana Ahmed | Favors conventional Ahmed

Analysis 10.2. Comparison 10 Pars plana versus conventional Ahmed implant for glaucoma with penetrating keratoplasty, Outcome 2 Intraocular pressure outcomes at 2 years follow-up.

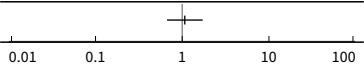
Study or subgroup	Pars plana Ahmed n/N	Conventional Ahmed n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
10.2.1 Complete success				
Parihar 2016	7/25	9/25		0.78[0.34,1.76]
10.2.2 Qualified or complete success				
Parihar 2016	18/25	19/25		0.95[0.68,1.32]



Favors conventional Ahmed | Favors pars plana Ahmed

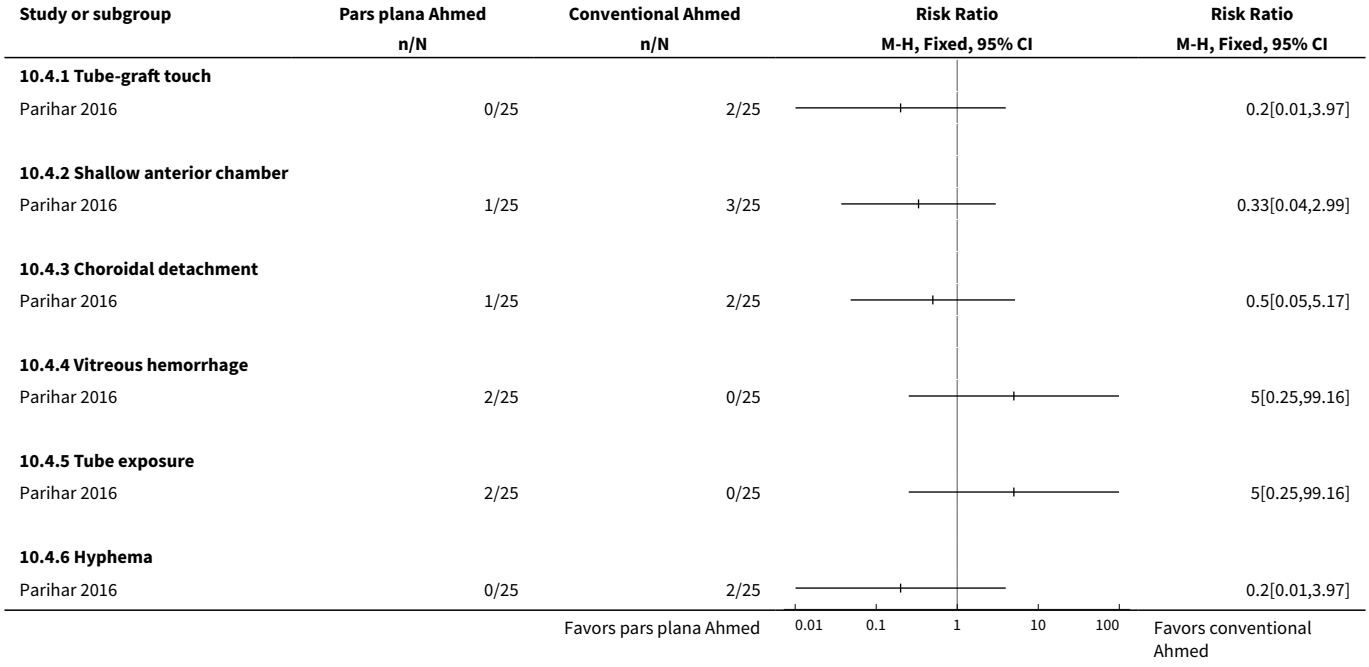
Analysis 10.3. Comparison 10 Pars plana versus conventional Ahmed implant for glaucoma with penetrating keratoplasty, Outcome 3 Visual acuity improvement of 2 lines or more on Snellen chart at 2 years follow-up.

Study or subgroup	Pars plana Ahmed n/N	Conventional Ahmed n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Parihar 2016	15/25	14/25		1.07[0.67,1.72]



Favors conventional Ahmed | Favors pars plana Ahmed

Analysis 10.4. Comparison 10 Pars plana versus conventional Ahmed implant for glaucoma with penetrating keratoplasty, Outcome 4 Complications at 2 years follow-up.

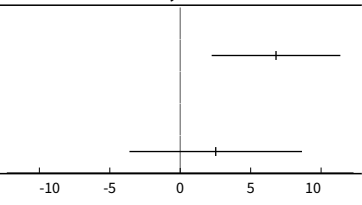


Comparison 11. Ahmed model M4 versus Ahmed model S2 for neovascular glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.1 At 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 At 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2 Visual acuity between 20/20 and 20/100 at 1 year follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3 Complications 1 day after surgery	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Total complications	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Hyphema, tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 DC	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.5 Contact with the iris	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.6 Flat grade 1 chamber	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 11.1. Comparison 11 Ahmed model M4 versus Ahmed model S2 for neovascular glaucoma, Outcome 1 Mean intraocular pressure at 1 year follow-up.

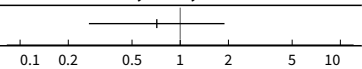
Study or subgroup	Ahmed model M4		Ahmed model S2		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
11.1.1 At 6 months follow-up						
Gil-Carrasco 2016	21	19.9 (10)	21	13.1 (3.8)		6.8[2.23,11.37]
11.1.2 At 1 year follow-up						
Gil-Carrasco 2016	18	18.9 (9.7)	21	16.4 (9.8)		2.52[-3.6,8.64]



Favors Ahmed model M4 | Favors Ahmed model S2

Analysis 11.2. Comparison 11 Ahmed model M4 versus Ahmed model S2 for neovascular glaucoma, Outcome 2 Visual acuity between 20/20 and 20/100 at 1 year follow-up.

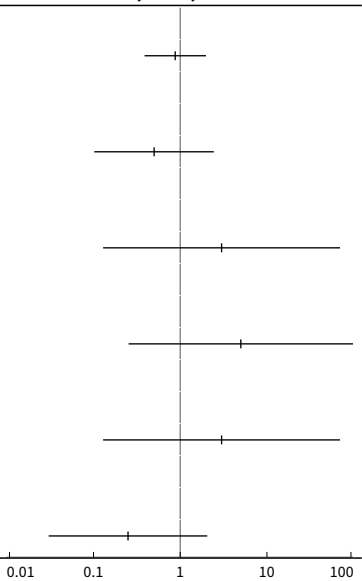
Study or subgroup	Ahmed model M4	Ahmed model S2	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Gil-Carrasco 2016	5/21	7/21		0.71[0.27,1.89]



Favors Ahmed model M4 | Favors Ahmed model S2

Analysis 11.3. Comparison 11 Ahmed model M4 versus Ahmed model S2 for neovascular glaucoma, Outcome 3 Complications 1 day after surgery.

Study or subgroup	Ahmed model M4	Ahmed model S2	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
11.3.1 Total complications				
Gil-Carrasco 2016	7/21	8/21		0.88[0.39,1.98]
11.3.2 Hyphema				
Gil-Carrasco 2016	2/21	4/21		0.5[0.1,2.44]
11.3.3 Hyphema, tube obstruction				
Gil-Carrasco 2016	1/21	0/21		3[0.13,69.7]
11.3.4 DC				
Gil-Carrasco 2016	2/21	0/21		5[0.25,98.27]
11.3.5 Contact with the iris				
Gil-Carrasco 2016	1/21	0/21		3[0.13,69.7]
11.3.6 Flat grade 1 chamber				
Gil-Carrasco 2016	1/21	4/21		0.25[0.03,2.05]



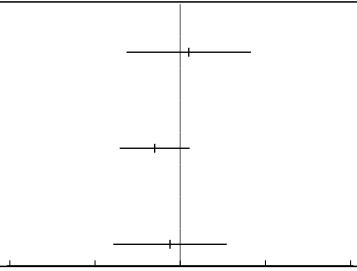
Favors Ahmed model M4 | Favors Ahmed model S2

Comparison 12. 500 mm^2 Baerveldt implant versus 350 mm^2 Baerveldt implant for non-neovascular glaucoma

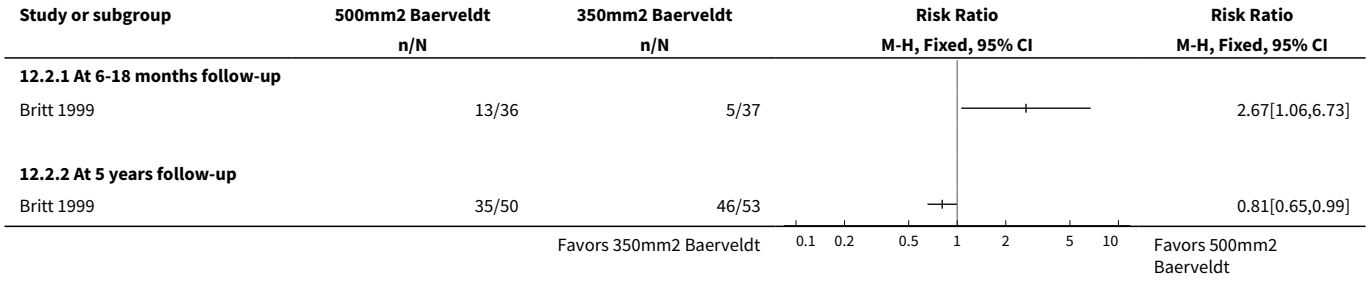
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
1.1 At 1 year follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.2 At 3 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
1.3 At 5 years follow-up	1		Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2 Intraocular pressure outcomes	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
2.1 At 6-18 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 At 5 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3 Complications at 5 years follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3.1 Diplopia/strabismus	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Anterior uveitis	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Retinal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.4 Tube obstruction	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.5 Choroidal effusion/detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 12.1. Comparison 12 500 mm^2 Baerveldt implant versus 350 mm^2 Baerveldt implant for non-neovascular glaucoma, Outcome 1 Mean intraocular pressure.

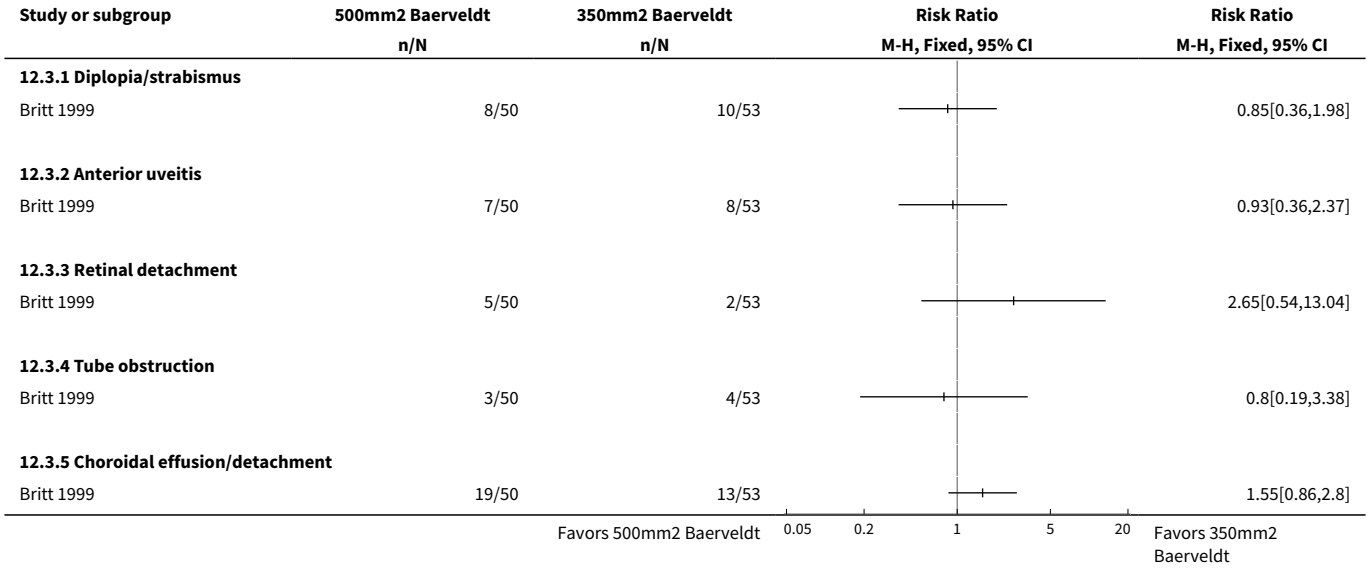
Study or subgroup	500 mm2 Baerveldt N	500 mm2 Baerveldt Mean(SD)	350 mm2 Baerveldt N	350 mm2 Baerveldt Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
12.1.1 At 1 year follow-up						
Britt 1999	44	14.8 (11.8)	52	14.3 (4)		0.5[-3.15,4.15]
12.1.2 At 3 years follow-up						
Britt 1999	29	12.2 (4.1)	31	13.7 (4)		-1.5[-3.55,0.55]
12.1.3 At 5 years follow-up						
Britt 1999	12	13.1 (5.1)	19	13.7 (3.7)		-0.6[-3.93,2.73]



Analysis 12.2. Comparison 12 500 mm^2 Baerveldt implant versus 350 mm^2 Baerveldt implant for non-neovascular glaucoma, Outcome 2 Intraocular pressure outcomes.



Analysis 12.3. Comparison 12 500 mm^2 Baerveldt implant versus 350 mm^2 Baerveldt implant for non-neovascular glaucoma, Outcome 3 Complications at 5 years follow-up.



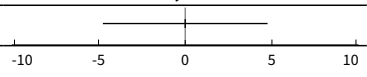
Comparison 13. Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mean intraocular pressure at 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2 Intraocular pressure outcomes at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3 Visual acuity within 1 Snellen line or improved at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
4 Mean antiglaucoma medications at 6 months follow-up	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5 Need for reoperation to control glaucoma progression	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
6 Complications at 6 months follow-up	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
6.1 Hyphema	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.2 Tube exposure	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.3 Choroidal detachment	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
6.4 Strabismus/motility disorder	1		Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

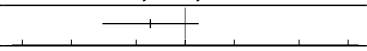
Analysis 13.1. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 1 Mean intraocular pressure at 6 months follow-up.

Study or subgroup	Molteno with steroids		Molteno alone		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Fixed, 95% CI	Fixed, 95% CI
Valimaki 1999	10	16.6 (6.8)	11	16.6 (3.7)		0[-4.75,4.75]



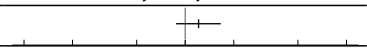
Analysis 13.2. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 2 Intraocular pressure outcomes at 6 months follow-up.

Study or subgroup	Molteno with steroids	Molteno alone	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Valimaki 1999	5/10	9/11		0.61[0.31,1.21]



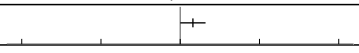
Analysis 13.3. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 3 Visual acuity within 1 Snellen line or improved at 6 months follow-up.

Study or subgroup	Molteno with steroids	Molteno alone	Risk Ratio	Risk Ratio
	n/N	n/N	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Valimaki 1999	10/10	9/11		1.21[0.88,1.66]



Analysis 13.4. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 4 Mean antiglaucoma medications at 6 months follow-up.

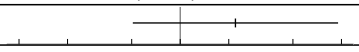
Study or subgroup	Molteno with steroids N	Molteno with steroids Mean(SD)	Molteno alone N	Molteno alone Mean(SD)	Mean Difference Fixed, 95% CI	Mean Difference Fixed, 95% CI
Valimaki 1999	10	2.2 (1.1)	11	1.4 (0.7)		0.8[0,1.6]



Favors Molteno with steroids — Favors Molteno alone

Analysis 13.5. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 5 Need for reoperation to control glaucoma progression.

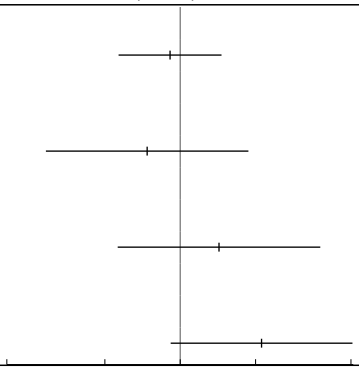
Study or subgroup	Molteno with steroids n/N	Molteno alone n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
Valimaki 1999	4/10	2/11		2.2[0.51,9.53]



Favors Molteno with steroids — Favors Molteno alone

Analysis 13.6. Comparison 13 Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant alone for glaucoma, Outcome 6 Complications at 6 months follow-up.

Study or subgroup	Molteno with steroids n/N	Molteno alone n/N	Risk Ratio M-H, Fixed, 95% CI	Risk Ratio M-H, Fixed, 95% CI
13.6.1 Hyphema				
Valimaki 1999	2/10	3/11		0.73[0.15,3.53]
13.6.2 Tube exposure				
Valimaki 1999	0/10	1/11		0.36[0.02,8.03]
13.6.3 Choroidal detachment				
Valimaki 1999	1/10	0/11		3.27[0.15,72.23]
13.6.4 Strabismus/motility disorder				
Valimaki 1999	5/10	0/11		12[0.75,192.86]



Favors Molteno with steroids — Favors Molteno alone

ADDITIONAL TABLES

Table 1. Interventions evaluated in trials included in this review

Author year	Comparison and population	Number of eyes per group experimental/control	Maximum follow-up time point reported
Aqueous shunts compared with trabeculectomy with or without MMC (4 trials)			
Wilson 2000	Ahmed implant versus trabeculectomy with or without MMC for primary open- or closed-angle glaucoma	55/62	1 year (11 to 13 months)

Table 1. Interventions evaluated in trials included in this review *(Continued)*

Wilson 2003	Ahmed implant versus trabeculectomy with or without MMC for primary open- or closed-angle glaucoma	59/64	4 years (50 to 52 months)
Pakravan 2007	Ahmed implant with MMC versus trabeculectomy with MMC for pediatric aphakic glaucoma	15/15	Not reported
TVT 2009	Baerveldt 350 mm^2 implant versus trabeculectomy with MMC for glaucoma with previous trabeculectomy or cataract surgery	107/105	5 years
Aqueous shunts compared with other aqueous shunts (5 trials)			
ABC 2011	Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma	143/133	5 years
AVB 2011	Ahmed implant versus 350 mm^2 Baerveldt implant for glaucoma	124/114	3 years
Nassiri 2010	Ahmed implant versus single-plate Molteno implant for glaucoma	46/46	2 years
Smith 1992	Double-plate Molteno versus Schocket shunt for glaucoma	19/21	Not reported
Wilson 1992	Double-plate Molteno versus Schocket shunt for glaucoma	65/53	6 months
Aqueous shunts compared with and without modification (18 trials)			
Law 2016	Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma	26/26	2 years
Pakravan 2014	Ahmed implant with early aqueous suppression versus Ahmed implant with standard medication regimen for glaucoma	47/47	1 year
Desai 2013	Ahmed implant with intravitreal ranibizumab versus Ahmed implant alone for open-angle glaucoma	6/5	6 months
Arcieri 2015	Ahmed implant with intravitreal bevacizumab versus Ahmed implant alone for neovascular glaucoma	20/20	2 years
Mahdy 2013	Ahmed implant with intravitreal bevacizumab and panretinal photocoagulation versus Ahmed implant with panretinal photocoagulation for neovascular glaucoma	20/20	18 months
Rojo-Arnao 2011	Ahmed implant with subconjunctival bevacizumab versus Ahmed implant alone for glaucoma	7/6	3 months
Teixeira 2012	Ahmed implant with intravitreal triamcinolone versus Ahmed implant alone for neovascular glaucoma	22/27	1 year
Yuen 2011	Ahmed implant with topical dexamethasone versus Ahmed implant with topical ketorolac for glaucoma	15/13	12 weeks
Yazdani 2016	Ahmed implant with amniotic membrane versus Ahmed implant alone for glaucoma	20/23	1 year
Rho 2015	Ahmed implant with biodegradable collagen matrix versus Ahmed implant alone for glaucoma	22/21	6 months

Table 1. Interventions evaluated in trials included in this review *(Continued)*

Hwang 2004	Ahmed implant with pericardium versus Ahmed implant alone for glaucoma	10/10	6 months
Kee 2001	Ahmed implant with partial tube ligation versus Ahmed implant with no ligation for glaucoma	16/16	6 months
Parihar 2016	Pars plana Ahmed implant versus conventional Ahmed implant for glaucoma with penetrating keratoplasty	29/29	2 years
Gil-Carrasco 2016	Ahmed implant model M4 versus Ahmed implant model S2 for neovascular glaucoma	21/21	1 year
Britt 1999	500 mm^2 Baerveldt implant versus 350 mm^2 Baerveldt implant for non-neovascular glaucoma	52/55	5 years
Valimaki 1999	Single-plate Molteno implant with oral corticosteroids versus single-plate Molteno implant without oral corticosteroids for glaucoma	11/11	6 months
Heuer 1992	Double-plate Molteno implant versus single-plate Molteno implant for non-neovascular glaucoma	66/66	Not reported
Gerber 1997	Pressure-ridge Molteno implant versus standard Molteno implant with tube ligation for glaucoma	15/15	12 weeks

MMC: mitomycin C

APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor: [Glaucoma] explode all trees
#2 MeSH descriptor: [Ocular Hypertension] explode all trees
#3 MeSH descriptor: [Intraocular Pressure] explode all trees
#4 glaucom*
#5 ((intra*ocular or ocular*) near/3 (hypertension* or tension* or pressur*))
#6 IOP
#7 MeSH descriptor: [Filtering Surgery] explode all trees
#8 MeSH descriptor: [Cataract Extraction] explode all trees
#9 (cataract* near/3 (extract* or surg* or operat* or remov*))
#10 {or #1-#9}
#11 MeSH descriptor: [Glaucoma Drainage Implants] explode all trees
#12 (Baerveldt* or Krupin* or Ahmed* or Molteno* or Schocket* or Joseph* or Optimed* or White or Hunan*)
#13 glaucom* and (Devic* or implant* or shunt* or valve* or tube* or drain* or seton*)
#14 {or #11-#13}
#15 #10 and #14

Appendix 2. MEDLINE Ovid search strategy

1. Randomized Controlled Trial.pt.
2. Controlled Clinical Trial.pt.
3. (randomized or randomised).ab,ti.
4. placebo.ab,ti.
5. drug therapy.fs.
6. randomly.ab,ti.
7. trial.ab,ti.
8. groups.ab,ti.

9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. exp animals/ not humans.sh.
11. 9 not 10
12. exp Glaucoma/
13. exp ocular hypertension/
14. exp intraocular pressure/
15. glaucom*.tw.
16. ((intra?ocular or ocular*) adj3 (hypertension* or tension* or pressur*)).tw.
17. IOP.tw.
18. exp filtering surgery/
19. exp Cataract Extraction/
20. (cataract* adj3 (extract* or surg* or operat* or remov*)).tw.
21. or/12-20
22. exp Glaucoma Drainage Implants/
23. (Baerveldt* or Krupin* or Ahmed* or Molteno* or Schocket* or Joseph* or Optimed* or White or Hunan*).tw.
24. (glaucom* and (Devic* or implant* or shunt* or valve* or tube* or drain* or seton*)).tw.
25. or/22-24
26. 21 and 25
27. 11 and 26

The search filter for trials at the beginning of the MEDLINE strategy is from the published paper by Glanville 2006.

Appendix 3. Embase.com search strategy

1. 'randomized controlled trial'/exp
2. 'randomization'/exp
3. 'double blind procedure'/exp
4. 'single blind procedure'/exp
5. random*:ab,ti
6. 1 OR 2 OR 3 OR 4 OR 5
7. 'animal'/exp OR 'animal experiment'/exp
8. 'human'/exp
9. 7 AND 8
10. 7 NOT 9
11. 6 NOT 10
12. 'clinical trial'/exp
13. (clin* NEAR/3 trial*):ab,ti
14. ((singl* OR doubl* OR trebl* OR tripl*) NEAR/3 (blind* OR mask*)):ab,ti
15. 'placebo'/exp
16. placebo*:ab,ti
17. random*:ab,ti
18. 'experimental design'/exp
19. 'crossover procedure'/exp
20. 'control group'/exp
21. 'latin square design'/exp
22. 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21
23. 22 NOT 10
24. 23 NOT 11
25. 'comparative study'/exp
26. 'evaluation'/exp
27. 'prospective study'/exp
28. control*:ab,ti OR prospectiv*:ab,ti OR volunteer*:ab,ti
29. 25 OR 26 OR 27 OR 28
30. 29 NOT 10
31. 30 NOT (11 OR 23)
32. 11 OR 24 OR 31
33. 'glaucoma'/exp
34. 'intraocular pressure'/exp
35. 'intraocular pressure abnormality'/de
36. 'ocular ischemic syndrome'/exp
37. glaucom*:ab,ti
38. ((intra*ocular OR ocular*) NEAR/3 (hypertension* OR tension* OR pressur*)):ab,ti

39. iop:ab,ti
40. 'filtering operation'/exp
41. 'cataract extraction'/exp
42. (cataract* NEAR/3 (extract* OR surg* OR operat* OR remov*)):ab,ti
43. #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42
44. 'glaucoma drainage implant'/exp
45. baerveldt*:ab,ti OR krupin*:ab,ti OR ahmed*:ab,ti OR molteno*:ab,ti OR schocket*:ab,ti OR joseph*:ab,ti OR optimed*:ab,ti OR white:ab,ti OR hunan*:ab,ti
46. glaucom*:ab,ti AND (devic*:ab,ti OR implant*:ab,ti OR shunt*:ab,ti OR valve*:ab,ti OR tube*:ab,ti OR drain*:ab,ti OR seton*:ab,ti)
47. #44 OR #45 OR #46
48. #43 AND #47
49. #32 AND #48

Appendix 4. PubMed search strategy

#1 ((randomized controlled trial[pt]) OR (controlled clinical trial[pt]) OR (randomised[tiab] OR randomized[tiab]) OR (placebo[tiab]) OR (drug therapy[sh]) OR (randomly[tiab]) OR (trial[tiab]) OR (groups[tiab])) NOT (animals[mh] NOT humans[mh])
#2 Glaucom*[tw] NOT MEDLINE[sb]
#3 ((intraocular[tw] OR ocular*[tw]) AND (hypertension*[tw] OR tension*[tw] OR pressur*[tw])) NOT MEDLINE[sb]
#4 IOP[tw] NOT MEDLINE[sb]
#5 (cataract*[tw] AND (extract*[tw] OR surg*[tw] OR operat*[tw] OR remov*[tw])) NOT MEDLINE[sb]
#6 #2 OR #3 OR #4 OR #5
#7 (Baerveldt*[tw] OR Krupin*[tw] OR Molteno*[tw] OR Molteno*[tw] OR Schocket*[tw] OR Joseph*[tw] OR Optimed*[tw] OR White[tw] OR Hunan*[tw]) NOT MEDLINE[sb]
#8 Glaucom*[tw] AND (Devic*[tw] OR implant*[tw] OR shunt*[tw] OR valve*[tw] OR tube*[tw] OR drain*[tw] OR seton*[tw]) NOT MEDLINE[sb]
#9 #7 OR #8
#10 #6 AND #9
#11 #1 AND #10

Appendix 5. LILACS search strategy

(MH:C11.525$ OR glaucoma$ OR "Ocular Hypertension" OR "Hipertensión Ocular" OR "Hipertensão Ocular" OR MH:G14.440$ OR ((intraocular OR "intra-ocular" OR ocular$) AND (hypertension$ OR tension$ OR pressur$)) OR "Presión Intraocular" OR "Pressão Intraocular" OR IOP OR MH:E04.540.450$ OR MH:E04.540.825.249$ OR ((cataract$ OR Catarata OR MH:C11.510.245$) AND (extract$ OR surg $ OR operat$ OR remov$))) AND (MH:E07.695.250$ OR "Implantes de Drenaje de Glaucoma" OR "Implantes para Drenagem de Glaucoma" OR Baerveldt$ OR Krupin$ OR Ahmed$ OR Molteno$ OR Schocket$ OR Joseph$ OR Optimed$ OR White OR Hunan$ OR Device$ OR implant $ OR shunt$ OR valve$ OR tube$ OR drain$ OR seton$)

Appendix 6. ClinicalTrials.gov search strategy

(glaucoma OR hypertension OR intraocular pressure) AND (device OR implant OR implants OR shunt OR valve OR tube OR drain OR drainage OR seton OR Baerveldt OR Krupin OR Ahmed OR Molteno OR Schocket OR Joseph OR Optimed OR White OR Hunan)

Appendix 7. ICTRP search strategy

Glaucoma AND device OR Glaucoma AND implant OR Glaucoma AND implants OR Glaucoma AND shunt OR Glaucoma AND valve OR Glaucoma AND tube OR Glaucoma AND drain OR Glaucoma AND drainage OR Glaucoma AND seton OR Glaucoma AND Baerveldt OR Glaucoma AND Krupin OR Glaucoma AND Ahmed OR Glaucoma AND Molteno OR Glaucoma AND Schocket OR Glaucoma AND Joseph OR Glaucoma AND Optimed OR Glaucoma AND White OR Glaucoma AND Hunan OR Hypertension AND device OR Hypertension AND implant OR Hypertension AND implants OR Hypertension AND shunt OR Hypertension AND valve OR Hypertension AND tube OR Hypertension AND drain OR Hypertension AND drainage OR Hypertension AND seton OR Hypertension AND Baerveldt OR Hypertension AND Krupin OR Hypertension AND Ahmed OR Hypertension AND Molteno OR Hypertension AND Schocket OR Hypertension AND Joseph OR Hypertension AND Optimed OR Hypertension AND White OR Hypertension AND Hunan

Intraocular pressure AND device OR Intraocular pressure AND implant OR Intraocular pressure AND implants OR Intraocular pressure AND shunt OR Intraocular pressure AND valve OR Intraocular pressure AND tube OR Intraocular pressure AND drain OR Intraocular pressure AND drainage OR Intraocular pressure AND seton OR Intraocular pressure AND Baerveldt OR Intraocular pressure AND Krupin OR Intraocular pressure AND Ahmed OR Intraocular pressure AND Molteno OR Intraocular pressure AND Schocket OR Intraocular pressure AND Joseph OR Intraocular pressure AND Optimed OR Intraocular pressure AND White OR Intraocular pressure AND Hunan

WHAT'S NEW

Date	Event	Description
27 June 2017	New citation required and conclusions have changed	Issue 7, 2017: Scope revised to exclude comparison of aqueous shunts with versus without mitomycin C (Foo 2015); new studies and analyses
27 June 2017	New search has been performed	Issue 7, 2017: Updated searches yielded 27 trials that met the inclusion criteria

HISTORY

Protocol first published: Issue 3, 2004
Review first published: Issue 2, 2006

Date	Event	Description
21 October 2008	Amended	Converted to new review format
1 December 2005	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Contributions in review update:

Screening search results and full-text articles: VLT, MYC, JC
Data extraction and 'Risk of bias' assessments: VLT, MYC
Analysis and interpretation of data: VLT, ALC, MYC, JC
Writing the review: VLT, JC
Providing substantive feedback for the update: ALC, JC

DECLARATIONS OF INTEREST

None of the authors have any conflicts of interest to disclose.

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  The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the Systematic Reviews Programme, NIHR, NHS or the Department of Health.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We updated some methods for this review based on Cochrane methods that have evolved since the last version of this review (Minckler 2006). We used the 'Risk of bias' tool, produced 'Summary of findings' tables, and assessed the certainty of evidence based on the GRADE approach. Because a substantial number of eligible randomized controlled trials have been identified, we modified the eligibility criteria to exclude quasi-random studies; this modification did not affect inclusion for this review. We also excluded studies that compared the use of mitomycin C versus no mitomycin C in aqueous shunt surgery, as this comparison will be evaluated in another Cochrane review (Foo 2015). We revised IOP threshold definitions from the original review based on more stringent and detailed criteria reported in the literature.

INDEX TERMS

Medical Subject Headings (MeSH)

*Glaucoma Drainage Implants [adverse effects]; *Intraocular Pressure; Cataract Extraction; Glaucoma [*surgery]; Molteno Implants [adverse effects]; Ocular Hypertension [surgery]; Randomized Controlled Trials as Topic; Trabeculectomy

MeSH check words

Humans