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Combined phacoemulsification and Ahmed valve glaucoma drainage implant: A retrospective case series

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PURPOSE. *To report on the efficacy and safety of combined phacoemulsification and an Ahmed valve glaucoma drainage implant with respect to visual acuity improvement, intraocular pressure (IOP) control, and requirement for antiglaucoma medication.*
METHODS. *A retrospective chart review was conducted of 41 eyes (31 patients) with coexisting visually significant cataracts and uncontrolled glaucoma who had combined phacoemulsification and Ahmed valve implantation. The outcome measures were: visual acuity, IOP, antiglaucoma medication requirements, and intra- and post-operative complications. Success was categorized as absolute (IOP<21 mmHg without the need for antiglaucoma medication) and relative (IOP<21 mmHg with one or more antiglaucoma medications). Failure was considered to be an IOP<6 mmHg or IOP>21 mmHg on maximally tolerated medications or any devastating complication.*
RESULTS. *The mean patient age was 67.3±5.9 years old. The mean visual acuity improved from 0.73±0.5 to 0.16±0.16 (p=0.000). The mean IOP decreased from 28.2±3.1 to 16.8±2.1 (p=0.000, 40.4%), while the number of antiglaucoma medication decreased from 2.6±0.66 to 1.2±1.4 (p=0.000). The absolute and relative success rates were 56.1% and 31.7%, respectively; 5 eyes (12.2%) were considered failures. There were no intraoperative complications; postoperative complications occurred in 8 eyes (19.5%). A hypertensive phase was detected in 12 (29.3%) eyes.*
CONCLUSIONS. *Combined phacoemulsification and Ahmed valve glaucoma drainage implantation is a safe and effective alternative to phacotrabeculectomy in patients with coexisting cataract and refractory glaucoma. (Eur J Ophthalmol 2008; 18: 191-8)*

KEY WORDS. *Antiglaucoma medication, Glaucoma drainage implant, Intraocular pressure, Phacoemulsification, Visual acuity*

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INTRODUCTION

The coexistence of glaucoma and cataract has been increasing due to the aging population and the higher probability of cataract formation or development in glaucomatous eyes. Cataracts can occur as a consequence of several conditions, including glaucoma surgery (1-6) and antiglaucoma drug therapy (7-9). Thus, it is common to encounter patients who have both visually significant cataract and glaucoma. The challenge when dealing with patients who have a cataract in a glaucomatous eye is selecting the optimal glaucoma surgical procedure, the optimal cataract surgery method, and the sequence of surgery, since the initial procedure may influence the outcome of the subsequent procedure.

Glaucoma drainage implants are indicated in the treatment of complicated and refractory glaucomas, both as a primary surgical approach (10-12) and as a secondary procedure in patients in whom trabeculectomy with or without adjunctive antifibrotic modulation either has failed

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or is reported to have a very low chance of success (10,13-19), including pediatric glaucomas (20-25), neovascular glaucomas (26), and a variety of glaucomas associated with uveitis (27-30). Additionally, in recent years, the use of glaucoma drainage implants has increased, especially relative to other surgical glaucoma procedures such as trabeculectomy (31, 32). Thus, combined phacoemulsification and glaucoma drainage implant surgery is a potential alternative to phacotrabeculectomy and would have the advantage of good visual rehabilitation and intraocular pressure (IOP) control, as well as less risk of failure and complications associated with conventional prelimbal filtering surgery. The combined approach offers patients the benefit of having a single surgical experience, thus reducing the risks of repeated surgery and saving costly operating room time.

This study evaluated the efficacy and safety of combined phacoemulsification and Ahmed valve glaucoma drainage implant with respect to visual acuity rehabilitation, IOP control, and antiglaucoma medication requirement.

MATERIALS AND METHODS

A retrospective chart review was conducted of 41 eyes (31 patients) with coexisting visually significant cataract and uncontrolled glaucoma that underwent combined phacoemulsification and Ahmed valve glaucoma drainage implantation over a 12-month period. All operations were performed by the same right-handed and experienced surgeon, Dr. Nader Nassiri, between November 2003 and July 2005 in the Vanak Eye Surgery Center (a non-training center) and the Imam Hossein Medical Center (a training center) located in Tehran, Iran. The implants were done in patients with refractory glaucoma, defined as an IOP >21 mmHg despite adequate conventional medical, laser, surgical treatment (not including a tube shunt), or some combination thereof.

Presurgical assessment included identifying the type of glaucoma, determining previous laser and surgical treatments, biomicroscopic examination, funduscopy, visual acuity (VA), baseline intraocular pressure (IOP), documenting the number of antiglaucoma medications, and assessing the visual field. The logMAR best-corrected visual acuity was measured using a Snellen chart calibrated for a 20-foot (~6 meter) distance by the line assignment method. IOP was measured using applanation tonometry. The use of glaucoma medication was reported as the number of drugs (topical or systemic) used; the type or frequency of medications was not noted. Preoperatively, all patients provided their written informed consent using a form approved by the Ethics Committee of Shaheed Beheshti University of Medical Sciences in accordance with the Declaration of Helsinki.

Outcome measures

Postoperative evaluation was done at the time of the patients' clinic visits; in general, the patients were seen 1 day, 1 week, 2 weeks, and 1, 3, 6, 9, and 12 months postoperatively. Postoperative evaluations included assessment of VA, IOP (mmHg), the number of antiglaucoma medications, and the occurrence of intra- and postoperative complications.

The success rate was defined based on the IOP and was subdivided into absolute (IOP >6 mmHg and IOP <21 mmHg without any antiglaucoma medication) and relative (IOP >6 mmHg and IOP <21 mmHg with one or more antiglaucoma medications). Failure was defined as any one of the following: IOP <6 mmHg or IOP >21 mmHg on maximally tolerated medications on two consecutive visits; loss of light perception; removal of the implant; further glaucoma surgery; and any devastating intra- or postoperative complication. Hypotony was defined as an IOP <6 mmHg, and a hypertensive phase was defined as an IOP >21 mmHg during the first 3 postoperative months for which no obvious cause could be identified.

Procedure

The tube shunt that was used was a valved 185 mm^2 surface area Ahmed implant (New World Medical Inc., Rancho Cucamonga, CA, USA). Preoperatively, all patients received topical ciprofloxacin (Ciloxan®) in the operative eye. All operations were performed by the same right-handed, experienced surgeon (Nader Nassiri) in an outpatient setting. Thirty minutes prior to surgery, the eyes were dilated with tropicamide 1% and phenylephrine 5%. General anesthesia was given in most cases; in some cases, peribulbar block consisting of lidocaine 2% with hyaluronidase (Wydase®) was used. Immediately before surgery in the operating room, povidone-iodine 10% was applied to the skin of the eyelids of the operative eye, nose, and forehead. The operative eye was draped in the usual manner for ophthalmic surgery. A lid speculum was placed, and the operating microscope was adjusted. Next, a corneal traction suture was placed, and fornix-based con-

junctival and Tenon flaps were fashioned superotemporally or superonasally. The sites were chosen depending on factors such as scleral thinning, conjunctival scarring, accessibility of the orbit, presence of peripheral anterior synechiae, and depth of the anterior chamber. To prime the valve, the tube of the Ahmed valve was irrigated with a balanced saline solution. The plate was secured 8 to 9 mm posterior to the surgical limbus with interrupted 7-0 nylon sutures using tapered cutting needles. Next, standard, sutureless bimanual clear corneal phacoemulsification with implantation of a foldable acrylic posterior chamber intraocular lens (Alcon, Fort Worth, TX, USA) was performed. After phacoemulsification, the tube was trimmed to extend approximately 2–3 mm beyond the surgical limbus with the bevel facing up; it was then inserted into the anterior chamber through a 23-gauge needle tract. The tube was anchored to the sclera using a 10-0 nylon suture and covered with a rectangular scleral patch graft. The conjunctiva was closed using 10-0 interrupted nylon sutures. At the end of surgery, 1 mg vancomycin hydrochloride (Vancocin®), 10 mg/mL, was instilled intracamerally. Postoperatively, topical antibiotic (Ciprofloxacin) and corticosteroid eyedrops were used; they were then gradually discontinued over 6 weeks.

RESULTS

The patients' characteristics are summarized in Table I.

Visual acuity

Preoperatively, the mean ± standard deviation of logMar equivalents of visual acuity was 0.73±0.5. The mean visual acuity was 0.18±0.15 at 1 week, 0.16±0.16 at 1 month, 0.15±0.15 at 3 months, 0.15±0.15 at 6 months, and 0.16±0.16 at 12 months. Changes in logMar equivalent visual acuity compared to preoperative values were assessed at the specified times. Kolmogorov-Smirnov and Shapiro-Wilk tests failed to show that the differences were normally distributed ($p<0.05$). The Wilcoxon signed rank test was used to investigate whether surgery had any effect on visual acuity. The difference between the preoperative values and the postoperative values was statistically significant ($Z=5.6$ and $p=0.000$) at all times; the preoperative value was greater than the postoperative value at all follow-up times. This finding is confirmed by the graph of logMar equivalents of visual acuity versus time (Fig. 1). At 12 months postoperatively, the mean and standard deviation of logMar equivalents of visual acuity were 0.16 and 0.16, respectively. Figure 2 also shows the proportions of patients with logMar >0.2 or ≤0.2 during the 12 months of follow-up.

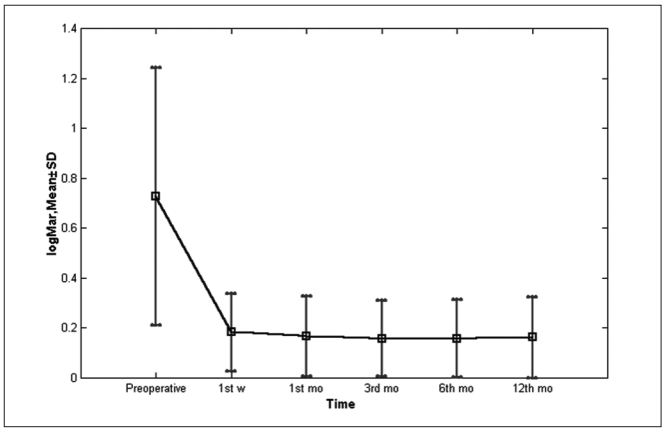

Fig. 1 - *LogMar equivalents of visual acuity versus time of subjects undergoing combined phacoemulsification and Ahmed valve glaucoma drainage implant.*

TABLE I - DEMOGRAPHICS OF SUBJECTS UNDERGOING COMBINED PHACOEMULSIFICATION AND AHMED VALVE GLAUCOMA DRAINAGE IMPLANT (31 patients, 41 eyes)

	Number (%)
Gender	
Male	14 (45.2)
Female	17 (54.8)
Age, yr, mean ± SD	67.3±5.85
Glaucoma subtypes	
Primary open-angle	23 (56.1)
Neovascular	5 (12.2)
Chronic angle closure	4 (9.8)
Post-traumatic	3 (7.3)
Steroid induced	2 (4.9)
Uveitic	2 (4.9)
Pseudophakic	1 (2.4)
Pigmentary	1 (2.4)
Diabetes mellitus	7 (17.1)
Systemic hypertension	8 (19.5)
Positive family history of glaucoma	5 (12.2)
Bilateral glaucoma	22 (53.7)
Laser peripheral iridectomy	5 (12.2)
Previous trabeculectomy	12
0	29 (70.7)
1	4 (9.8)
2	7 (17.1)
3	1 (2.4)

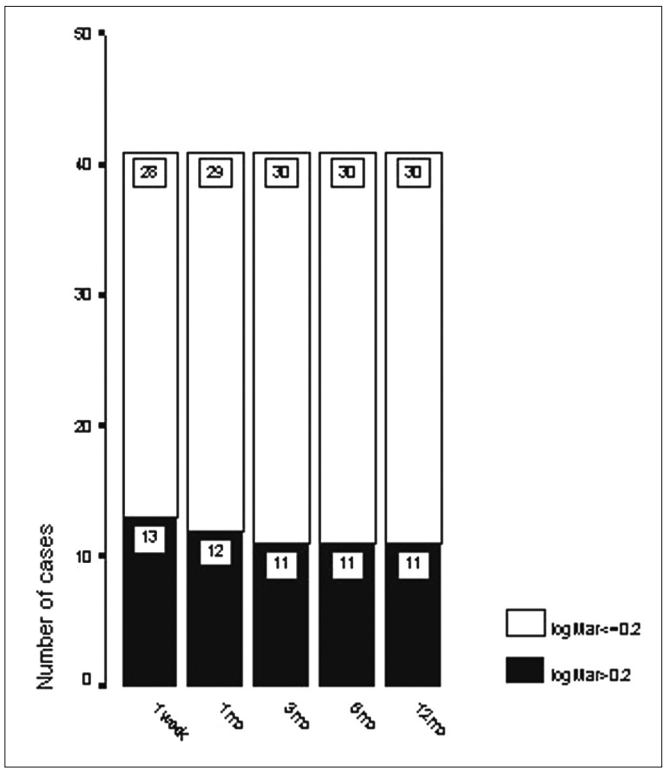

Fig. 2 - *Proportion of patients with logMar >0.2 or ≤0.2 versus time.*

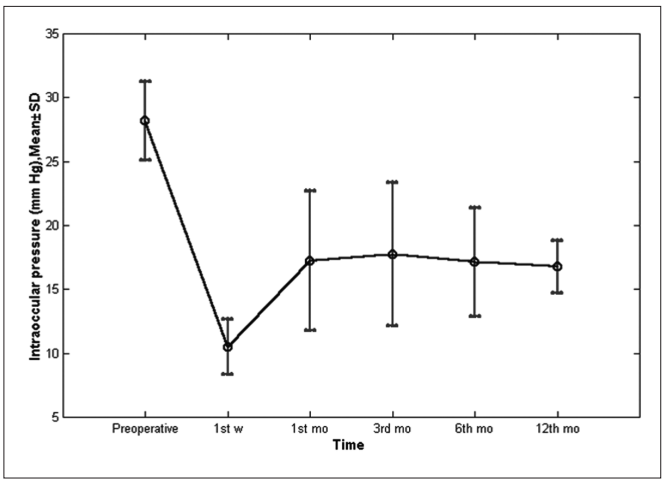

Fig. 3 - *Intraocular pressure changes versus time in subjects undergoing combined phacoemulsification and Ahmed valve glaucoma drainage implant.*

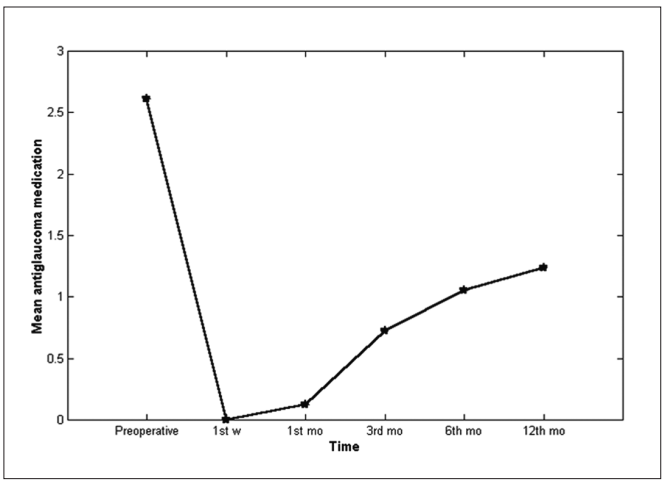

Fig. 4 - *Changes in the mean number of antiglaucoma medications required in subjects undergoing combined phacoemulsification and Ahmed valve glaucoma drainage implant.*

Intraocular pressure

The mean ± standard deviation preoperative IOP was 28.2±3.1 mmHg. Postoperatively, the mean IOP was 10.5±2.1 mmHg at 1 week, 17.2±5.4 mmHg at 1 month, 17.75±5.6 mmHg at 3 months, 17.15±4.2 mmHg at 6 months, and 16.8±2.1 mmHg at 12 months. The postoperative values were lower than the mean preoperative value for all of the studied intervals (p=0.0 and n=41). IOP changes over time are shown in Figure 3. The mean IOP fell 17.7 mmHg during the first week, but it then rose 6.73 mmHg at 1 month follow-up. Thereafter, the IOP appeared to reach a plateau level, stabilizing at around 17 mmHg; the standard deviation decreased, especially at 3-month follow-up. At 12-month follow-up, the mean and standard deviation of the IOP were 16.8 and 2.1, respectively.

Medication

Preoperatively, the mean number of antiglaucoma medications was 2.6±0.66, with a mode of 3 (29 patients, 70.7%). In the first week of operation, none of the patients required medication. The mean number of required medications was 0.12±0.4 at 1 month, 0.7±1.1 at 3 months, 1.05±1.3 at 6 months, and 1.2±1.4 at 12 months. Figure 4 shows the changes in the mean number of antiglaucoma drugs required over time.

The total number of antiglaucoma medications used by all patients at the time of each follow-up ($\Sigma^{xf(x)}$) was also calculated, where x is the number of medications (0, 1, 2, 3) and f(x) is the matrix of drug use frequencies at the intervals. This total number changed from 107 preoperatively to 37 at the time of the last follow-up (12 months). The re-

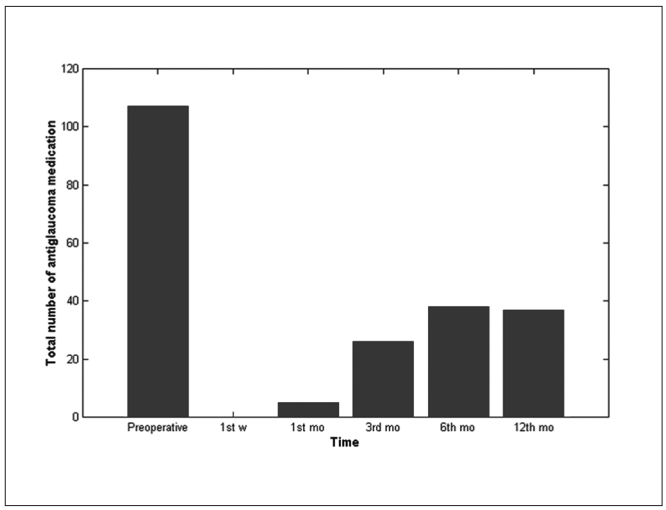

Fig. 5 - *Total number of antiglaucoma medications used at the time of each follow-up.*

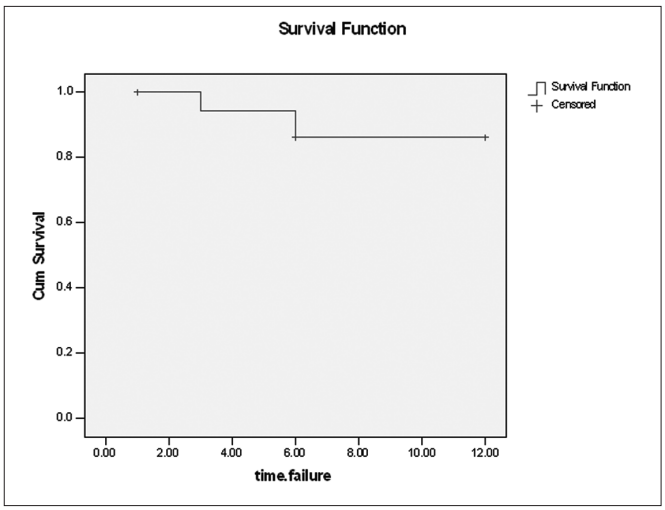

Fig. 6 - *Kaplan-Meier failure-free survival curve of subjects undergoing combined phacoemulsification and Ahmed valve glaucoma drainage implant.*

sults are shown in Figure 5. Postoperatively, antiglaucoma medication requirements were lower at all follow-up times (p=0.0).

Figure 6 shows the Kaplan-Meier failure-free survival analysis for all subjects. At 12 months after surgery, there were five cases of failure (two within 3 months and three between 3 and 6 months); 87.8% of patients had a successful result (relative, 13 [31.7%]; absolute, 23 [56.1%]).

Complications

There were no intraoperative complications. Only 8 (19.5%) eyes had postoperative complications, and 33 eyes had no postoperative complications. Table II shows the postoperative complications; some eyes had more than one complication.

TABLE II - POSTOPERATIVE COMPLICATIONS OF SUBJECTS UNDERGOING COMBINED PHACOEMULSIFICATION AND AHMED VALVE GLAUCOMA DRAINAGE IMPLANT (N=41 eyes)

Complication	Number (%)
Tenon cyst	4 (9.7)
Hyphema	2 (4.9)
Tube occlusion	2 (4.9)
By fibrin	1 (2.4)
By iris	1 (2.4)
Choroidal effusion	1 (2.4)
Shallow anterior chamber	1 (2.4)

DISCUSSION

In the current study, the efficacy and safety of combined phacoemulsification, lens implantation, and Ahmed valve glaucoma drainage implant were retrospectively evaluated in 41 eyes (31 patients) with 1 year of follow-up. Statistical analysis showed that the combined approach resulted in excellent IOP control, reduction of antiglaucoma medications, and improved visual acuity. In terms of visual acuity, the mean preoperative visual acuity (logMar equivalent) was 0.73±0.5, which improved to 0.18±0.15 at 1-week follow-up; it remained almost constant during follow-up. At 12-month follow-up, 30 eyes (73.2%) had a visual acuity (logMar) improvement of 0.2 or better. With regard to IOP, at 12-month follow-up, the mean IOP reduction was 40.4% (from 28.2 to 16.8 mmHg).

To compare our results with those of previous studies (11, 12, 14, 16, 33), our definitions of success and failure were based on the IOP level. However, compared to evaluation of glaucomatous optic nerve damage and visual field loss, the IOP level is not an ideal mea-

sure of success of any glaucoma therapy, whether medical or surgical. This is due to individual differences in susceptibility to the damaging effect of IOP. On Kaplan-Meier analysis, the cumulative probability of absolute and relative success was 56.1% and 31.7%, respectively. In this study, 5 eyes (12.2%) failed to achieve an IOP less than 21 mmHg with maximal antiglaucoma medications at 12-month follow-up: 3 of these eyes had a history of two previous failed trabeculectomies, 1 eye had uveitic glaucoma, and 1 eye had neovascular glaucoma. At the time of failure, the mean IOP was 24.6±2.07, and the mean number of antiglaucoma medications was 2.8±0.44. Our success rate (87.8%) is comparable to that of previous studies that showed success rates of 58% to 96% for glaucoma implant surgery alone (not combined with cataract extraction) (11-14, 27, 34-37). However, the use of different outcome criteria, different drainage implants, and different glaucoma subtypes, as well as racial differences, may make it difficult to compare the results of the various studies. Nevertheless, the results suggest that cataract extraction does not have a negative effect on tube shunt function. Furthermore, various studies have shown that cataract extraction in eyes with preexisting glaucoma implants improves vision and is consistent with the maintenance of IOP control (38-41).

Table II shows the postoperative complications; our results are comparable to those of other studies (18, 33, 36, 42). The incidence of the hypertensive phase has been reported to be between 26% and 84% with the Ahmed valve glaucoma drainage implant (16, 37, 43). In our study, based on the definition of the hypertensive phase as an IOP greater than 21 mmHg during the first 3 months postoperatively with no obvious cause, a hypertensive phase was observed in 12 eyes (29.3%). It occurred after a mean of 6 weeks (1–10 weeks). The mean IOP at the time of onset was 30.08±3.28, and the average maximum number of antiglaucoma medications was 1.83±0.57. In 7 of 12 eyes (58.3%), resolution occurred within 6 months. Four eyes had no significant improvement of IOP control and continued to require the same number of glaucoma medications as they did during the hypertensive phase.

Hoffman et al (42) showed that IOP was controlled successfully in 89% of patients 18 months after combined cataract and Baerveldt glaucoma drainage implant surgery. Molteno et al (44) prospectively analyzed a series of combined cataract extraction and implant insertion (45 eyes) or trabeculectomy (94 eyes) for a mean follow-up of 5.3 years and 3.9 years, respectively. They found that cataract extraction combined with the insertion of Molteno implants or trabeculectomy controlled the IOP in 100% (45/45) and 94% (88/94) of cases, respectively. Chung et al (33) conducted a retrospective chart review of 32 patients who had combined phacoemulsification, lens implantation, and Baerveldt (16 eyes) or Ahmed (16 eyes) implant surgeries. The results showed complete and qualified success in 63% and 13% of the Baerveldt glaucoma implants, respectively, and 87% and 13% of the Ahmed valve implants, respectively.

The results of the present study suggest that combined phacoemulsification and Ahmed valve glaucoma drainage implant is safe and effective; this approach can be a good alternative to phacotrabeculectomy. However, further prospective, multicenter studies including a larger cohort of patients with longer follow-up and involving various types of glaucoma drainage implants are warranted.

The authors have no financial or proprietary interest in any product, method, or material described.

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