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# FLEXIBLE AHMED VALVE FOR SELECTED CASES OF REFRACTORY GLAUCOMA

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**Aim:**

*To evaluate flexible Ahmed glaucoma valve implant for selected cases of refractory glaucoma regarding its efficiency in controlling intraocular pressure and possible postoperative complications of its implantation and their management.*

**Method:**

*Patients included in this study were selected from patients with uncontrolled intraocular pressure by conventional filtration surgery as well al maximum tolerable topical medical treatment when surgery or laser is unlikely to control intraocular pressure. For every patient, complete history and ocular examination were done. Ahmed glaucoma valve flexible plate implant (FP7 and FP8) was used.*

**Results:**

*Intraucolar pressure decreased from a mean preoperative of (40.36 ± 4.8) mmHg with a range of 32 mmHg to 58 mmHg to a mean postoperative value of (18.73 ± 4.8) mmHg with a range from 14.0 mmHg 28.0 mmHg and the criteria of success were applied on 92.5% of eyes.*

**Conclusion:**

*Flexible Ahmed glaucoma valve plate implant is satisfactory method for controlling the elevated intraocular pressure in cases of refractory glaucoma with success rate 92.5% and less incidence of immediate postoperative and implant-related complications.*

Refractory glaucoma's have many variable definitions and include: advanced congenital or infantile glaucoma, juvenile glaucoma, neovascular glaucoma, glaucoma associated with aphakia and pseudophakia, glaucoma associated with uveitis, traumatic glaucoma, post-keratoplasty glaucoma, glaucoma in blacks, malignant glaucoma and recurrent primary glaucoma [1, 2].

Glaucoma drainage implants are a useful alternative in treating glaucomas that are resistant to medical therapy and conventional glaucoma filteration surgery [3].

Mane modern designs of implants have been introduced. These implants are describes are described as posterior tube shunt implants which include: nonvalved implants such as (molteno, schocket & Baerveldt implants), valved implants such as (Krupin, Joseph & white Ahmed implants) and glaucoma pressure regulator (optimed implant). The valved and pressure regulator implants incorporate an element (valve or matris) to restrict aqueous flow and prevent postoperative hypotony, flat anterior chamber and other sequalae [2].

A new model of Ahmed glaucoma valve (FP-7 is slightly tapered to facilotate insertion of the device under the conjunctiva and tenon's capsule [4].

**Aim of the work:**

To evaluate flexible Ahmed glaucoma valve implant for selected cases of refractory glaucoma regarding its efficiency in controlling intraocular pressure and possible postoperative complications of its implantation and their management.

**Patients and methods:**

The study considered patients with refractory glaucomas; those with uncontrolled intraocular pressure by conventional filtration surgery as well as maximum tolarable topical medical treatments when surgery or laser in unlikely to control intraocular pressure.

***For every patient, the following was done:***

**(1) History**: with special attention to age, sex and history of present or previous ocular disease, previous procedure or laser therapy, systemic disease as diabetus milletus and present or previous use of antiglaucoma medical treatment.

**(2) Ocular examination**: with special attention to measurement of intraocular pressure using Goldmann applanation tonometer or schiotez tonometer, measurement of best corrected visual acuity using the Landolet broke ring chart, slit lamp biomicroscopy for assessment of condition of the conjunctiva and previous filtering bleb, condition of the cornea, depth of anterior chamber, presence or absence of rubeosis iridis and posterior synechie, condition of the lens (in phakic patient) or posterior capsule integrity (in aphakic patient) and condition of vitreous face and its anterior third, gonioscopy using the Goldmann 3 mirror contact lens for detection of anterior chamber angle width, peripheral anterior synachie, neovascularization and obstruction of internal opening of a previously failed trabeculectomy by membrane or iris tissue, fundus examination for detection of preoperative cup/disc ratio and visual field whenever possible.

In cases of congenital glaucoma, ocular examination were performed under general anaesthesia with

special attention for horizontal corneal diameter and its clarity.

The cases were selected after exclusion of patients with dense diffuse corneal opacity, visual acuity No perception of light, marked scleral thinning or staphylomatous changes especially in the upper quadrant of the globe and extensive peripheral anterior synachie with subsequent peripheral loss of anterior chamber especially at the proposed site of the tube entry.

Ahmed glaucoma valve flexible implant (FP7 and FP8) were chosen for this study (figure 1, 2).

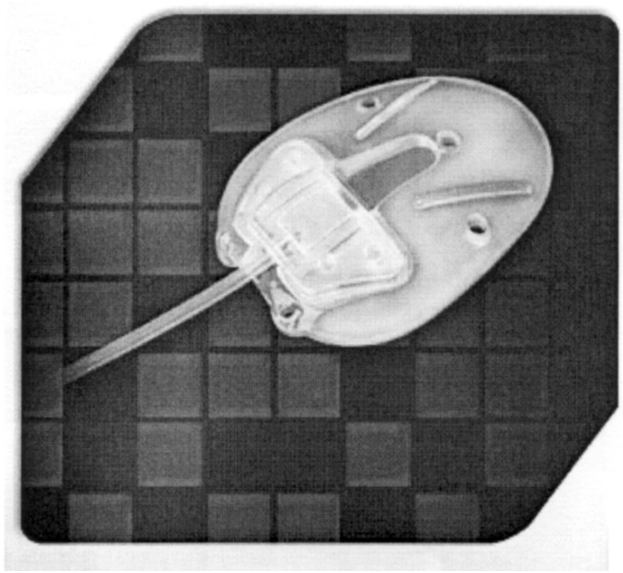

**Figure 1. Flexible Ahmed glaucoma valve FP7.**

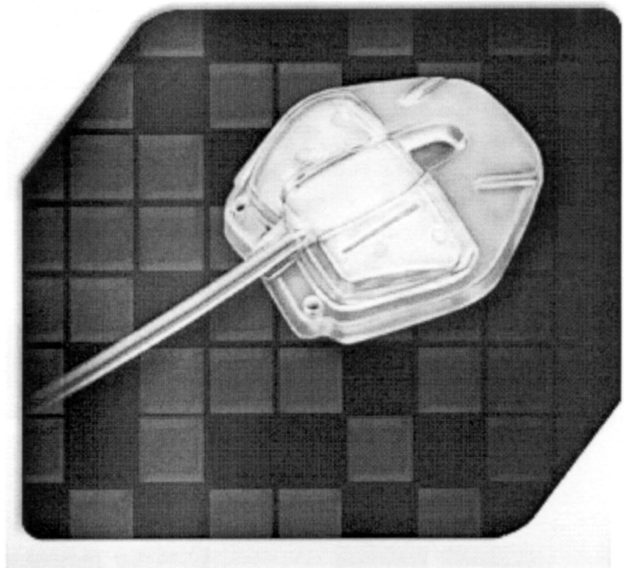

**Figure 2. Flexible Ahmed glaucoma valve FP8.**

**Surgical technique: (figure 3, 4).**

• A lid speculum was applied and a superior rectus traction suture was taken.

• A 90° — fornix — based conjunctival flap was created and a pocket was formed between the episclera and tenon's capsule by blunt dissection between the lateral and superior rectus muscles.

• A 2/3 thickness limbal — based scleral flap (about 4 × 4 mm) was dissected and carried forward into clear corneal for 1 mm.

• The valve was primed by injecting balanced salt solution slowly through the open end of the drainage tube using a 27 gauge blunt cannula and syringe.

• The implant was inserted into the previously formed pocket between the lateral and superior rectus musches. Then its body was fixed to the sclera by passing (7/0) vicryl sutures through the holes on the anterior edge of the valve body. The anterior edge of the body must be 10 mm posterior to the limbus.

• A corneal stab incision was created temporally just inside the limbus using a 30° — angle superblade. A viscoelastic agent (e. g. sodium hyaluronate) was injucted through this track to deepen the anterior chamber to allow good insertion of the gube into the anterior chamber to the proper length and in the proper plane.

• The anterior chamber was entered just inside the limbus with a 23 gauge needle. The tract formed by the needle was anterior and parallel to the plane of the iris (midway between the iris and cornea). Then the tube was trimmed to allow a 2-3 mm length inside the anterior chamber and a bevel towards the corneal endothelial surface.

• The trimmed tube was then inserted into the anterior chamber under the scleral flap.

• A fixation mattress 7/0 vicryl sutures was taken to fix the tube to the episclera between the anterior edge of the implant body and the posterior end of the scleral flap. Then the scleral flap was sutured over the tube with 8/0 virgin silk sutures.

• The conjunctiva and tenon's capsule were closed with 8/0 virgin silk or 10/0 nylon sutures.

• Subconjunctival injection of gentamycine 40 mg and dexamethasone 4 mg at the end of surgery.

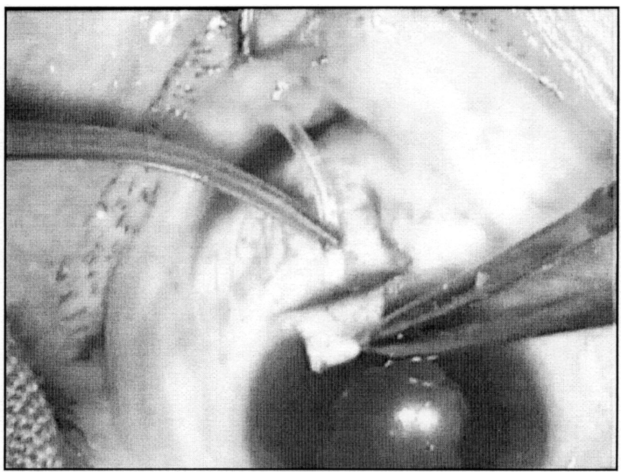

**Figure 3. Insertion of the trimmed tube into the anterior chamber after implantation of the valve.**

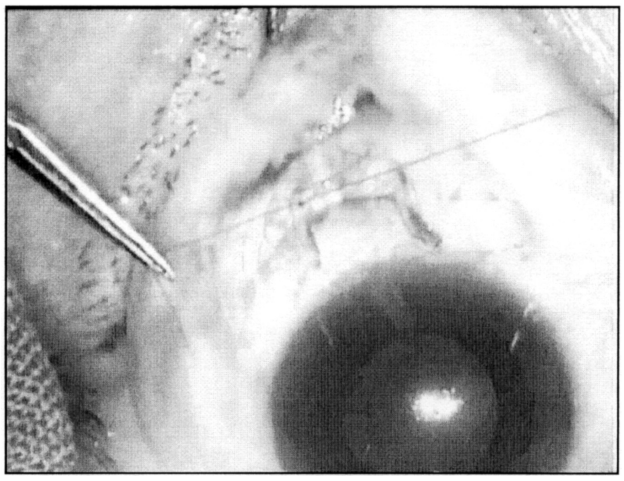

**Figure 4. Fixation mattress suture.**

**Post-operative therapy:**

1) Systemic treatment: systemic antibiotic and indomethcin at a dose of 75 mg/day, as a non-steroidal anti-inflammatory drug.

***2) Topical treatment:***

Dexamethasone eye drops 0/1%, 4 times daily with gradual tapering.

Atropine eye drops or ointment 1%, 3 times daily.

Antibiotic eye drops, 4 times daily.

Post operative follow up examination was done daily for a week, weekly for a month, monthly for 6 months than every three months with assessment of best corrected visual acuity, cup/disc ratio and visual field. Corneal diameter was measured in cases of congenital glaucoma.

**Criteria of success:**

***a) Compete (absolute) success:***

Cases were considered absolutely successful when: The intraocular pressure was equal or less than 21 mm Hg and equal or greater than 6 mm Hg, for a minimum of 6 months, without antiglaucoma medical treatment, without additional glaucoma surgery or visually devastating complications (e. g. endophthalmits) and without further increase in corneal diameter (in congenital glaucoma).

***b) Partial success:***

Cases were considered partially successful when the above criteria were fulfilled with addition of antiglaucoma topical medical treatment (Beta-blocker eye drops twice daily).

**Results:**

The present study included 40 eyes of 40 patients (25 males and 15 females) with the age ranged between 5 months and 65 years with a mean of 34.77 ± 27.6 years (Table 1).

Table 1

**Preoperative data of the patients**

| Number of eyes | Diagnosis | Age (mean) | IOP (mean) | B.C.V.A. (mean) | C/D ratio (mean) | Fundus | Gonioscopy |
|---|---|---|---|---|---|---|---|
| 10 | Recurrent primary open angle glaucoma (2 subscleral trabeculectomy) | 58y | 34 | 6/24 | 0.7 | NAD | Open angle |
| 14 | Neovascular glaucoma | 61y | 44 | 3/60 | 0.6 | Proliferative diabetic retinopathy + Panretinal photo coagulation | Closed angle |
| 6 | Neovascular glaucoma | 56y | 38 | 6/60 | 0.7 | Proliferative diabetic retinopathy | Closed angle |
| 10 | Recurrent primary congenital glaucoma | 7m | 38 | — | 0.5 | NAD | Open angle |

The preoperative intraocular pressure ranged between 32 mmHg and 58 mmHg with a mean of 40.36 ± 7.78 mmHg. The preoperative intraocular pressure readings were recorded while all patients were under anti-glaucoma medications.

The preoperative corneal diameter of eyes with congenital glaucoma ranged between 12.5 and 16 mm with a mean of 14.25 ± 1.24 mm.

Fundus examination in eyes with neovascular glaucoma (twenty eyes) showed proliferative diabetic retinopathy, fourteen of them had laser pan-retinal phococoagulation before surgery while fundus examinations of patient with recurrent primary open angle glaucoma and primary congenital glaucoma were free.

Gonioscopy showed closure of the angle of anterior chamber with vasculized membrane in all patients with neovascular glaucoma and translucent amorphous material in all patients with recurrent primary congenital glaucoma while the angles were opened in all eyes with recurrent primary open angle glaucoma.

The preoperative cup/disc ratio ranged between 0.4 and 0.8 (Tabl. III).

All patients with congenital glaucomas had undergone previous glaucoma surgeries ranging between one and three trabeculotomies.

The preoperative best corrected visual acuity ranged between counting fingers 50 cm and 6/24.

After six months follow-up, the criteria of success were applied on 37 eyes of 40 eyes (92.5%). They included thirty eyes (81.8%) with absolute success and only seven eyes (18.9%) with partial success (Beta blocker eye drops 0.5% twice daily were needed in both eyes). However, the criteria of failure were applied on three eye (7.5%) because of elevation of the intraocular pressure more than 21 mmHg from the first post-operative month and for two months in spite of the use of beta-blocker eye drops 0.5% twice daily during this period due to tube blockage with blood in neovascular glaucoma.

During the six post-operative months of follow-up, the mean post-operative intra-ocular pressure was the least on the first post-operative day (7.27 ± 2.57 mmHg) with a maximum percentage of reduction from the mean preoperative level, while it was the highest in the fourth post-operative months (19.63 ± 6.12 mmHg) with a minimum percentage of reduction from the mean preoperative level.

After six months of follow up, the intraocular pressure had decreased from a mean preoperative value of 40.36 ± 7.78 mmHg with a range of 32 mmHg to 58 mmHg to mean post-operative value of 18.73 ± 4.8 mmHg with a range of 14.0 mmHg to 28.0 mmHg (figure 5).

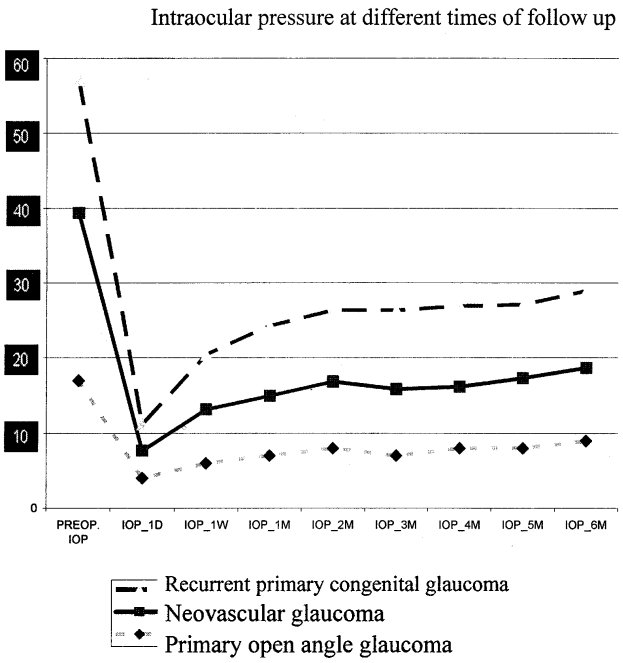


**Fig. 5. Intraocular pressure (IOP) at different times of follow up.**

As regards the post-operative corrected visual acuity, thirteen eyes (32.5%) showed visual improvement after surgery, twelve eyes (30%) maintained the same preoperative visual acuity while five eyes (12.5%) shows visual deterioration due to vitreous hemorrhage. The other eyes cannot be assessed (congenital glaucoma).

**Post-operative complications.**

Shallow anterior chamber had occurred in one eye (2.5%) with neovascular glaucoma where the anterior chamber was reformed spontaneously on the forth post-operative day. Hypotony and serous choroidal detachment was found in only one eye (2.5%) with neovascular glaucoma. This choroidal detachment resolved completely within the seventh post-operative day. Encapsulated (non functioning) bleb caused by extensive conjunctival scarring around the implant occurred in one eye (3.5%) with recurrent primary congenital glaucoma.

**Discussion.**

In this study, the Ahmed Glaucoma Valve flexible plate implant has been used in 40 eyes of 40 patients with different types of refractory glaucomas. A total success rate of 92.5% was found after a follow up period of 6 months.

Law et al. (2005) [5] have compared the safety and efficacy of the polypropylene and silicone flexible plate Ahmed glaucoma valve in the management of adult refractory glaucomas. They reported more intraocular pressure reduction with silicone than with polypropylene Ahmed glaucoma valve.

Success rates, similar to these results have been recorded with both valved and non valved drainage implants. Valved implant such as Joseph implant achieved 94% success rate after a follow up of sis months [6] and a 89% success rate was reported with white pump-shunt after mean follow up of 14 months [7]. Also, a success rate of 80% was obtained with silicone flexible plate Ahmed glaucoma valve after a follow up of 12 months [4]. On the other hand, non-valved implants such as Molteno implant achieved a success rate of 75% after mean follow up of 14 months [8] and an 85% success rate was reported with Schocket implant [9]. In addition a success rate of 79% was obtained with Baerveldt implant after a follow up of 12 months [10].

These results are not surprising, since all of the drainage implants shunt aqueous from the anterior chamber to the subconjunctival space. A limitation is that the tubes of the drainage implants without a valve mechanism need to be occluded with a ligature or stent to prevent overfiltration in the immediate post-operative period if one-stage implantation is done. However, occlusion of the tube does not prevent flat anterior chamber and the removal of the ligature involves additional surgical intervention if it does not spontaneously release. Also, early post-operative intraocular pressure is typically high because of tube occlusion.

In the present study, it is interesting to notice that, the incidence of immediate post-operative hypotony, flat anterior chamber and serous choroidal detachments appear to be less with the Ahmed Glaucoma Valve flexible plate implant than with other valved implants. Only one eye (2.5%) had intra-ocular pressure less than five mmHg on the first post-operative day.

This hypotony was associated with serous choroidal detachments.

Coleman et al. (1995) [11] reported a higher incidence (13%) of intraocular pressures less than 5 mmHg on the first post-operative day with the polypropylene Ahmed Glaucoma Valve implant. They noted that, in one quarter of eyes with hypotyny, a 22-gauge needle was used to form the tube tract. Thus, leakage of aqueous around the tube could be the cause of hypotony in these eyes. Now, a 23-gauge needle is the recommended size used by Coleman and his associated and other surgeons.

As regards other valved implants, like Krupin disk implant, 12 (34%) of 50 eyes had an intraocular pressure less than 5 mmHg on the first post-operative day [12].

In the present study, although none of the eyes had a lost (flat) anterior chamber, there was one shallow anterior chamber (2.5%) with the Ahmed Glaucoma Valve flexible plate implant. Shallow anterior chamber was spontaneously reformed with no further interventions.

Coleman et al. (1995) [11] reported a 3% incidence of shallow anterior chambers with the Ahmed Glaucoma Valve implant with no incidence of flat anterior chambers. Flat anterior chambers have also been reported in eyes with other valved drainage devices. 19% of eyes with white implant (White, 1992) [7], 21% of eyes with the Joseph implant [13] had flat anterior chambers.

In the present study, serous choroidal detachments were found only in one case (2.5%) which resolved completely within 7$^{th}$ day post-operative. Coleman et al. (1995) [11] reported with the Ahmed Glaucoma Valve implant a higher incidence (22%) of serous choroidal detachments.

As regards other valved implants, the incidence of serous choroidal detachments with the Krupin disk implant was reported to be 17 (34%) of 50 eyes [12].

This incidence of serous choroidal detachments is expected, since choroidal detachments are observed in eyes with non-valved implants in which the tube was ligated or occluded during one-stage implantation. Sixteen (43%) of 37 eyes with the Baerveldt 350-mm$^2$ implant were reported to have serous choroidal detachments.The number of choridal detachments was even greater with 500 mm$^2$ Baerveldt implant [4].

In the present study, no eyes showed tube endothelial touch due to insertion of the tube into the anterior chamber at the proper site midway between the iris and cornea and deepening of the anterior chamber with a viscoelastic substance (e. g. sodium hyaluranate) during this step are very helpful measures in the prevention of corneal complications with Ahmed glaucoma valve flexible plate implant.

In the present study, it is interesting to notice that, the incidence of failed (encapsulated) bleb is less with flexible Ahmed glaucoma valve (2.5%) than with other implants.

It was found that silicone is the most inert material and it was associated with the least amount of inflammation which may contribute to failure of the glaucoma drainage devices [15].

In this study, no eyes show tube migration either posterior migration (exteriorization) or anterior migration of the tube inside the anterior chamber as the posterior edge of the flexible Ahmed glaucoma valve is slightly tapered to facilitate insertion of the valve under the conjunctiva and tenons capsule also there are three fenestration holes for proper fixation of the valve. In addition to the sticky properties of silicone which provides stability of the valve in its place.

Mokbel (2005) [3] reported one eye with tube retraction and two eyes with tube endothelial touch due to forward tube malposition after implantation of polypropylene Ahmed glaucome valve and surgery was done to reintroduce the tube to the proper site.

In this study, there eye showed tube blockage while Coleman et al. (1995) [11] reported rube blockage in six (10%) of 60 eyes with Ahmed glaucoma valve implant. Three of the blocked tubes were in eyes with neovascular glaucoma and blocked with blood. Possibly, in the future, heparinizing the tubes may help in prevention of this type of complication in eyes prone to bleeding.

The blockage of tubes with fibrin, iris, or vitreous has been described with other valved implants and non valved implants. Fellenbaum et al. (1994) [16] reported that, blockage of the rube or slit valve occurred in five (20%) of 25 eyes with Krupin disk implants. Whereas, Lioyed et al. (1994) [14] reported a tube blockage in four (5.5%) of 73 eyes with Baerveldt implants.

In the present study, there were no cases with diplopia after flexible Ahmed glaucoma valve with takes the contour of the globe and the very small thickness of the valve (0.9 mm) if compared with polypropylene Ahmed glaucoma valve (1.9 mm). This will also contribute to absence of foreign body sensation in eyes with flexible Ahmed glaucoma valve which was previously manifested with polypropylene Ahmed glaucoma valve implantation. In addition, plate fenestrations are proved to limit the height of the filtering capsule, thus hopefully reduce the incidence of post operative ocular motility disorders.

Huang et la. (1999) [17] identified four eyes (3%) with motility disorders after polypropylene Ahmed glaucoma valve implantation and they explained this by mechanical displacement (mass effect) by the implant and the bleb, fat adherence syndrome or posterior fixation suture effect from scarring under the rectus muscle.

**Conclusion:**

Ahmed glaucoma valve flexible plate implant is a satisfactory method for controlling the elevated intraocular pressure in cases of refractory glaucoma with success rate 92.5% and less incidence of immediate postoperative and implant-related complications.

It is recommended to use 23 gauge needle to form the tube tract, deepen the anterior chamber by visco-

elastic substance, eliminate retinal ischemia by Laser pan-retinal photocoagulation and modifying manufacturing of flexible Ahmed glaucoma valve by heparinizing the tube to prevent tube blockage and adding a standard needle for creating anterior chamber entry to avoid possible leakage around the tube.

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## ГИБКИЙ КЛАПАН AHMED ДЛЯ ЛЕЧЕНИЯ РЕФРАКТЕРНОЙ ГЛАУКОМЫ

Th. H. Mokbel, M. A. Khalas, Sh. E. El-Klouly, N. O. El-Metwalas

Целью исследования было оценить эффективность имплантирования гибкого клапана Ahmed, проведенного на 40 глазах с рефрактерной глаукомой с учетом состояния внутриглазного давления и возможных послеоперационных осложнений.

В результате установлено, что данный метод лечения рефрактерной глаукомы оказался успешным на 37 из 40 прооперированных глазах (92,5%).

Внутриглазное давление перед проведением операции в среднем составляло (40,36 ± 7,78) мм рт. ст. Спустя 6 месяцев после операции уровень ВГД равнялся в среднем (18,73 ± 4,8) мм рт. ст., что являлось убедительным показателем эффективности метода. В пользу последнего свидетельствует также низкая частота послеоперационных осложнений, вызванных имплантацией клапана.