

Postoperative Blepharoptosis after Trabeculectomy versus Ahmed Glaucoma Valve Implantation

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Abstract

Purpose: To investigate the frequency of persistent postoperative ptosis (PP) following trabeculectomy or Ahmed glaucoma valve (AGV) implantation and to analyze the associated factors.

Methods: It is a prospective observational study on glaucoma patients who underwent trabeculectomy or AGV implantation from October 2015 to June 2017 in a tertiary center. Margin reflex distance 1 and 2 (MRD1 and 2) and levator function were measured before and at least 6 months, postoperatively. Clinically significant ptosis was defined as ≥ 2 mm drop of MRD1.

Results: One hundred and fourteen patients (124 eyelids) including 76 patients (87 eyelids) with trabeculectomy and 35 patients (37 eyelids) with AGV implantation were included. The mean age was 55.50 (standard deviation = 17.54) years. Most of the surgeries were performed under general anesthesia (87.9%, 109/124) between 30 and 60 min (53.2%, 66/124) by residents (39.5%, 49/124). Trabeculectomy and AGV groups did not differ in terms of pre, intra, and postoperative variables ($0.1 \leq P \leq 0.9$) except duration of surgery ($P = 0.01$) and sex ($P = 0.04$). Clinically significant persistent PP was observed in 12.9% (16/124) in total, 13.7% (12/87) in the trabeculectomy group, and 10.8% (4/37) in the AGV group ($P = 0.6$). Male gender (β coefficient = 2.56, 95% confidence interval (CI) = 4.76–0.36, $P = 0.02$) and a higher preoperative MRD1 (β coefficient = 1.24, 95% CI = 0.52–1.95, $P = 0.001$) were the only factors affecting the frequency of clinically significant PP.

Conclusions: Postoperative blepharoptosis occurred in 12.9% of eyes after glaucoma procedures. Male gender and higher preoperative MRD1 were significantly associated with a higher frequency of postglaucoma surgery blepharoptosis.

Keywords: Ahmed glaucoma valve, Glaucoma, Postoperative blepharoptosis, Trabeculectomy

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INTRODUCTION

Postoperative blepharoptosis (postoperative ptosis [PP]) is a known complication of intraocular procedures¹⁻³ which significantly affects the quality of life.⁴ Transient PP has been defined as ptosis lasting < 6 months, mainly due to eyelid edema and ocular inflammation.^{2,3} Persistent PP is, on the other hand, when the ptosis lasts for more than 6 months which is mainly attributed to the disinsertion or dehiscence of the levator muscle.^{2,3} Clinically significant PP was considered for a fall

of ≥ 2 mm in margin reflex distance 1 (MRD1).² Our group has recently reported the frequency of persistent clinically significant PP after modern phacoemulsification cataract surgery² and pars plana vitrectomy³ which were 3% and 11%, respectively.

There are 9 previous publications on the PP after trabeculectomy⁴⁻¹¹ and glaucoma drainage device (GDD) implantation.^{10,12} Follow-up duration of at least 6 months was

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reported in only 6 of them.^{4-6,8,9,11} Palpebral fissure height was used for the assessment of PP in two studies which is not as accurate as the MRD1 measurement due to the confounding effect of MRD2 on the assessment of blepharoptosis.^{5,6,13} Therefore, MRD1 based posttrabeculectomy persistent PP has been reported 13%,⁴ 17.4%,⁸ 19%,⁹ and 12.5%¹¹ in the 4 previous studies. Persistent PP has not been reported after the GDD implantation.

The aims of this study were to report the frequency of clinically significant persistent PP after trabeculectomy and Ahmed glaucoma valve (AGV) implantation and analyze the associated factors.

METHODS

Patients who were scheduled for different glaucoma procedures at a teaching hospital were prospectively enrolled from October 2015 to June 2017. The study adhered to the tenets of Declaration of Helsinki, and consent form as well as institutional review board approval were obtained (IR.IUMS. REC 1396.8821215191).

Exclusion criteria were the patients with systemic diseases that could have affected the palpebral fissure (thyroid eye disease, myasthenia gravis, muscular dystrophy, and Horner's syndrome), previous ocular and periocular surgery within the last 6 months, use of topical steroids within the last 3 months, upper face botulinum toxin injection within the last 6 months, and missing the final follow-up (6 months). Moreover, all eyelid measurements were performed in silent eyes with no signs of intraocular inflammation or conjunctival injection. The presence of any factor that interferes with the patient's direct gaze in primary position including a mentally disoriented patient, severe dry eye, or photophobia were excluded from the study.

Eyelid examination included MRD1 and 2, upper eyelid crease, and levator function (LF). Measurements were performed before and more than 6 months after surgery by the two observers (A.E. And S.J.) independently who were not involved in the surgery but knew the type of surgery. In cases of needling or antifibrotic injection, measurements were performed at least 3 months after these procedures. Each measurement was repeated 3 times, and the average was recorded. MRD1 and MRD2 were the distance from upper and lower eyelid margins to the corneal light reflex in primary position by asking the subjects to focus at a penlight hold in a distance of 50 cm.¹⁴ The LF was assessed by holding the frontalis muscle inactive at the brow and evaluating the distance between extreme downgaze to upgaze.¹⁴ Persistent clinically significant ptosis^{2,3} was defined as ≥ 2 mm drop of MRD1 at the last follow-up time of ≥ 6 months which was the primary outcome measure in this study. The secondary outcome measure was to assess the factors affecting the frequency of PP including type of anesthesia, duration of surgery, type of glaucoma surgery, surgeon's level (consultant, fellow, senior ophthalmology resident), postoperative use of antiglaucoma

medications and steroid, bleb needling, antifibrotic injections, and postoperative intraocular pressure (IOP).

The procedures (trabeculectomy and AGV) were performed under local or general anesthesia by different levels of surgeons. Lieberman adjustable rigid lid speculum was used in all subjects.

For AGV implantation, a fornix-based conjunctival incision was made in the superotemporal quadrant. Mitomycin C (MMC) 0.02% was then applied for 2 min and then irrigated with 50 CC balanced salt solution. AGV model FP7 (New World Medical, Rancho Cucamonga, LA, USA), was implanted at 10–11 mm from the limbus and sutured to the sclera with two 8-0 nylon sutures. The tube was trimmed beveled up and then inserted into the anterior chamber through the tunnel made by a 23-gauge needle at the posterior limbus. The tube was then secured to the sclera with a 10-0 nylon suture, covered with a donor sclera. The conjunctiva was sutured using 10-0 vicryl suture in a continuous fashion. At the end of the surgery, subtenon Methylprednisolone was injected deep in the inferotemporal fornix.

For trabeculectomy, an 8/0 silk traction suture was applied at the corneo-limbal junction at 12 o'clock, then a fornix-based 5–6 mm conjunctival peritomy was made from superior to superonasal quadrant. A half-thickness trapezoidal scleral flap (3 mm \times 2 mm) was then created at the superior sclera and MMC 0.02% was applied using multiple thin sponges under the scleral flap and between the sclera and Tenon capsule for 2–3 min. The sponges were then removed, and the surgical field was irrigated with copious amounts of balanced salt solution. Trabeculocorneal block was removed with a Kelly-Descemet punch, and a peripheral iridectomy was created with Vannas scissors. The scleral flap was secured with two 10-0 nylon sutures using the releasable technique. At the end of the surgery, the conjunctiva was closed with 10-0 nylon sutures, and subtenon Methylprednisolone was injected in the inferotemporal quadrant.

Statistical analysis

Data were entered with the SPSS software (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA: IBM Corp.). A logistic model with generalized estimating equations (GEE) estimator was performed to control the relation between the two eyes in one patient. A multivariate analysis of GEE was performed on variables with $P < 0.05$ on the univariate analysis to find the effect of different variables on clinically significant ptosis. A $P < 0.05$ was considered statistically significant.

RESULTS

After excluding 14 patients because of incomplete follow-up, 124 eyelids from 111 patients who underwent either trabeculectomy (87 eyelids from 76 patients) or shunt surgery (37 eyelids from 35 patients) were included. Open-angle glaucoma was the most frequent type of glaucoma [Table 1].

Table 1: Demographic, intraoperative, and postoperative characteristics in 111 patients (124 eyes) with either trabeculectomy or Ahmed glaucoma valve implantation

	Total	Trabeculectomy	AGV implantation	P ^a
Patients	111	76	35	-
Eyes	124	87	37	-
Mean (SD) age	55.50 (17.54)	56.73 (16.68)	52.85 (19.25)	0.47
Sex				
Female	36.0% (40/111)	30.3% (23/76)	48.6% (17/35)	0.04
Male	64.0% (71/111)	69.7% (53/76)	51.4% (18/35)	
Type of glaucoma				
Open angle	69.4% (86/124)	66.7% (58/87)	75.7% (28/37)	0.22
Angle closure	16.1% (20/124)	14.9% (13/87)	18.9% (7/37)	
Others	14.5% (18/124)	18.4% (16/87)	5.4% (2/37)	
Anesthesia				
General	87.9% (109/124)	86.2% (75/87)	91.9% (34/37)	0.40
Local	12.1% (15/124)	13.8% (12/87)	8.1% (3/37)	
Surgeons				
Ophthalmology residents	39.5% (49/124)	47.1% (41/87)	21.6% (8/37)	0.31
Glaucoma specialists	34.7% (43/124)	28.7% (25/87)	48.6% (18/37)	
Glaucoma fellows	25.8% (32/124)	24.1% (21/87)	29.7% (11/37)	
Duration of surgery (min)				
<30	3.2% (4/124)	3.4% (3/87)	2.7% (1/37)	0.01
30-60	53.2% (66/124)	60.9% (53/87)	35.1% (13/37)	
61-120	43.5% (54/124)	35.6% (31/87)	62.2% (23/37)	
Bleb needling (%)	4.0% (5/124)	4.6% (4/87)	2.7% (1/37)	0.63
Antifibrotic injection (%)	4.8% (6/124)	6.9% (6/87)	0% (0/37)	0.18
Duration of postoperative topical steroid (months)	3.81 (1.44)	3.80 (1.44)	3.82 (1.47)	0.96

^aGeneralized estimation equation analysis. SD: Standard deviation, AGV: Ahmed glaucoma valve

We had no case of neovascular glaucoma. The majority of surgeries were performed under general anesthesia [Table 1]. A significantly higher proportion of females and longer duration of procedure were observed in the shunt group [Table 1]. No other variables were significantly different between the two types of glaucoma procedures [Table 1]. MRD measurements were performed for a mean of 6.49 (standard deviation: 0.44) ranging from 6 to 7 months after surgery.

MRD1 did not change in 50.8% of the patients, decreased in 38.7% of them, and increased in 10.5% [Table 2]. The mean MRD1, however, significantly decreased from 3.07 mm to 2.65 mm [Table 2].

Significant reduction of MRD1 and MRD2 as well as increased eyelid crease height were observed only in the trabeculectomy group [Table 2]. Persistent clinically significant PP (≥ 2 mm) was not significantly different ($P = 0.6$) between the trabeculectomy (13.7%) and shunt procedure (10.8%) group [Table 2].

Male gender (β coefficient = 2.56, 95% confidence interval [CI] = 4.76–0.36, $P = 0.02$) and a higher preoperative MRD1 (β coefficient = 1.24, 95% CI = 0.52–1.95, $P = 0.001$) significantly associated with a higher frequency of postoperative clinically significant ptosis in both uni- and multi-variate analysis. Other variables did not show a significant effect on the postoperative clinically significant ptosis ($0.09 \leq P \leq 0.9$).

DISCUSSION

In the prior studies, PP after the glaucoma surgeries was defined based on MRD1, palpebral fissure, or subjective assessment.⁴⁻¹² Since MRD2 increases in some patients with blepharoptosis, an accurate definition of PP should be based on MRD1 rather than palpebral fissure.¹³ Furthermore, the objective (eyelid measurement) definition of ptosis is more accurate than the subjective one. Since a substantial proportion of PP tends to resolve within 6 months (transient PP) after the intraocular procedures,² real persistent PP should be defined at least 6 months after the surgery.²⁻¹² This study, similar to prior studies, defined the clinically significant persistent PP as ≥ 2 mm drop of MRD1 6 months after the glaucoma procedure.^{2,3} It was observed in 13.7% of the eyes after the trabeculectomy which was almost the same as prior reports [Table 3]. It was also observed in 10.8% of the eyes after the GDD implantation which is the first report on this group of patients. Transient PP after the GDD implantation, however, was assessed in two previous studies which were 18% and 32%.^{10,12}

PP after the glaucoma surgery could be attributed to multiple factors including myogenic, neurogenic, mechanical, and aponeurotic factors.^{15,16} Levator aponeurosis dehiscence might be attributed to the traction on the globe during the surgery.²⁻⁴ Bridle suture traction on the superior rectus muscle, eyelid speculum, and globe inferior traction might be the potential

Table 2: Comparing pre versus postoperative margin reflex distance 1 and 2, levator function and eyelid crease height in 124 eyes (111 patients) with either trabeculectomy or Ahmed glaucoma valve implantation

Variables	Total			Trabeculectomy (87 eyes in 76 patients)			AGV implantation (37 eyes in 35 patients)		
	Preoperative	Postoperative (6 months)	P ^a	Preoperative	Postoperative (6 months)	P ^a	Preoperative	Postoperative (6 months)	P ^a
Mean MRD1 (mm)	3.07 (SD: 1.11)	2.65 (SD: 1.19)	<0.001	3.24 (SD: 1.13)	2.76 (SD: 1.21)	<0.001	2.69 (SD: 0.97)	2.40 (SD: 1.15)	0.10
Mean MRD2 (mm)	4.98 (SD: 1.02)	4.79 (SD: 0.92)	0.02	5.04 (SD: 0.96)	4.79 (SD: 0.92)	0.01	4.84 (SD: 1.16)	4.78 (SD: 0.96)	0.65
Mean crease height (mm)	8.66 (2.14)	9.03 (SD: 2.14)	0.03	8.51 (SD: 2.21)	8.93 (SD: 2.06)	0.04	9.01 (SD: 1.97)	9.27 (SD: 2.37)	0.41
Mean levator function (mm)	13.61 (SD: 1.94)	13.66 (SD: 1.88)	0.77	13.65 (SD: 1.87)	13.65 (SD: 1.91)	0.98	13.52 (SD: 2.11)	13.70 (SD: 1.83)	0.52
MRD1 change									
Decreased (mm)									
4	-	0.8% (1/124)	-	-	1.1% (1/87)	-	-	0% (0/37)	-
3		4.0% (5/124)			3.4% (3/87)			5.4% (2/37)	
2		8.1% (10/124)			9.2% (8/87)			5.4% (2/37)	
1.5		3.2% (4/124)			3.4% (3/87)			2.7% (1/37)	
1		8.9% (11/124)			10.3% (9/87)			5.4% (2/37)	
0.5		13.7% (17/124)			14.9% (13/87)			10.8% (4/37)	
No change		50.8% (63/124)			47.1% (41/87)			59.5% (22/37)	
Increased		10.5% (13/124)			10.3% (9/87)			5.4% (2/37)	

^aGeneralized estimation equation. SD: Standard deviation, AGV: Ahmed glaucoma valve, MRD: Margin reflex distance

maneuvers leading to the dehiscence.¹⁷⁻¹⁹ A significantly higher postoperative eyelid crease and a good LF in this study imply the role of aponeurotic dehiscence.

The literature does not show agreement on the effect of various methods of anesthesia on PP.² Local anesthesia might lead to neuro and myotoxicity in different intraocular surgeries.^{2,5}

Moreover, orbicularis contracture during local or topical anesthesia may be a potential risk factor for developing PP.⁵ It is believed that PP would be less frequent when the surgery is done by general anesthesia because of lack of eyelid force against the speculae.²⁰

Deady *et al.*⁵ showed a higher incidence of PP after trabeculectomy with local anesthesia.⁵

In the current study, the majority of surgeries (near 88% of all cases) were performed under general anesthesia. Our results showed that the frequency of PP was not significantly different in patients with topical versus general anesthesia.

In the present study, all surgeries were performed under direct supervision of attendings. In addition, all of the AGV procedures were done by attendings or well-trained glaucoma fellows. A previous study regarding the outcomes of resident versus attending performed trabeculectomy showed comparable results with respect to long-term success rates and complications.²¹

Koh's study suggested that increased bleb height over a more localized area (small bleb area) might play an important role in PP development and should be considered in the evaluation of upper eyelid blepharoptosis.⁹ The bleb, GDD, and or the sutures could lead to a prolonged conjunctival inflammation under the upper eyelid which might result in PP.

We observed a higher persistent PP in male gender and patients with higher preoperative MRD1. None of the other variables showed a significant association with the PP in the current study. A recent meta-analysis on PP after intraocular surgeries, however, showed a lower risk for the male gender.²² While some studies reported an association between the PP and local anesthesia,⁵ black race,⁷ bleb morphology,⁹ age,¹⁰ deep superior sulcus,¹¹ and non-combined surgery,¹⁰ other studies did not find such an association with age,^{5-8,11} sex,^{5,6,10,11} spherical equivalent,⁸ preoperative MRD1,^{5,8} previous ocular surgery,^{6,10} combined cataract surgery,^{6,11} type of conjunctival flap⁶ (fornix based or limbal based), corneal traction suture,⁸ use of MMC,¹⁰ duration of surgery,¹⁰ type of speculum,¹⁰ postoperative IOP,⁸ IOP reduction,⁸ postoperative intervention,^{8,11} superior rectus hematoma in bridle suture,⁸ or steroid duration.¹⁰ Such controversy implies that none of the factors could be specifically attributed to the PP.

The frequency of PP after the glaucoma procedure (10.5%–12.9%) was higher than patients with modern cataract surgery (3%) and almost the same as after the vitrectomy procedure (11%).^{2,3} This implies that glaucoma procedures are causing more intraoperative damage to the upper eyelid levator muscle, similarly to the vitrectomy.

Table 3: Review of previous studies on postoperative ptosis after glaucoma surgeries

Authors	Year	Type of study	Type of procedure	Number of eyes	Assessment method	Definition of PP	Follow-up time (months)	Frequency of PP	Factors significantly increasing PP
Deady <i>et al.</i> ⁵	1989	Prospective	Trabeculectomy	30	Clinical	Decrease of PA ≥ 2 mm	6	6%	Local anesthesia
Song <i>et al.</i> ⁶	1996	Retrospective	Trabeculectomy \pm Phaco	386	Clinical	Decrease of PA ≥ 2 mm	6	12%	No factor
Altieri <i>et al.</i> ⁴	2005	Retrospective	Trabeculectomy \pm Phaco/ECCE	23	Clinical	Drop of MRD1 > 2 mm	6	13%	NM
Jampel <i>et al.</i> ⁷	2005	Prospective	Trabeculectomy	456	NM	NM	1	12%	Black race
Tsuchisaka <i>et al.</i> ⁸	2015	Prospective	Trabeculectomy + MMC	36	Clinical	Drop of MRD1 > 2 mm Absolute decrease of MRD1	3, 6	14% (at 3 months), 19% (at 6 months)	No factor
Koh <i>et al.</i> ⁹	2015	Retrospective	Trabeculectomy + MMC + Phaco	46	Clinical	Drop of MRD1 > 2 mm	6	17.4%	Reduced total bleb area, Increased bleb height
Park <i>et al.</i> ¹⁰	2017	Retrospective	Trabeculectomy \pm MMC \pm Phaco GDD implantation	68 89	Clinical	NM	3	Trabeculectomy: 10% GDD: 23%	Shunt surgery, noncombined surgery, age < 70 years
Roddy <i>et al.</i> ¹²	2020	Prospective	Trabeculectomy + MMC GDD implantation	46 42	Clinical	Drop of MRD1 > 2 mm Absolute decrease of MRD1	1, 3	Trabeculectomy: 18% (1 month), 22% (3 months) GDD: 18% (1 month), 32% (3 months)	NM
Fukushima <i>et al.</i> ¹¹	2020	Retrospective	Trabeculectomy \pm MMC \pm Phaco	96	Clinical	NM	12	12.5%	Deep upper eyelid sulcus
Current study	2021	Prospective	Trabeculectomy + MMC \pm Phaco AGV implantation	87 37	Clinical	Drop of MRD1 ≥ 2 mm Absolute decrease of MRD1	6	Trabeculectomy: 13.7% GDD: 10.8%	Male, higher preoperative MRD1

NM: Not mentioned, MRD: Margin reflex distance, PA: Palpebral aperture, ECCE: Extracapsular lens extraction, MMC: Mitomycin C, GDD: Glaucoma drainage device, AGV: Ahmed glaucoma valve, PP: Postoperative ptosis

On the other hand, while Park *et al.*¹⁰ reported a higher frequency of transient (3 months) PP after GDD than trabeculectomy, the current study did not find a significant difference in the persistent PP between the two groups. The type of implant in different studies might be the reason for different surgical manipulation and exposure which might lead to a different frequency of PP.¹⁰ Their patients had both Ahmed and Baerveldt devices in the GDD group. Baerveldt device with nearly 350 mm² could induce more mechanical force on upper eyelid compared to Ahmed device with 184 mm². Ahmed valve was the GDD in our study. The same transient (3 months) PP was reported for the patients with trabeculectomy and GDD implantation in another study without mentioning the type of GDD.¹²

Limitations were lack of photographic documentation, not blind observers, absence of a control group, not including other types of GDD such as Baerveldt tubes, and a small sample size, especially in the GDD group. Although the sample size of GDD was smaller than trabeculectomy, as shown in Table 1, the sample size is similar to Roddy *et al.*¹² and half of Park *et al.*¹⁰ which was retrospective.

In conclusion, clinically significant persistent PP was observed in 13.7% of the patients undergoing trabeculectomy and 10.5% undergoing GDD implantation procedure. The surgeons should be aware of this potential complication and discuss with patients preoperatively.

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Conflicts of interest

There are no conflicts of interest.

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