Trabeculectomy or gonioscopy-assisted transluminal trabeculotomy: Which is a better surgical option for pseudophakic pseudoexfoliative glaucoma?

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ABSTRACT

Purpose: To compare the outcomes of gonioscopy-assisted transluminal trabeculotomy (GATT) and trabeculectomy in pseudophakic eyes with pseudoexfoliative glaucoma (PXG).

Materials and Methods: This retrospective case-series included a total of 36 pseudophakic eyes with PXG, 17 in the GATT group and 19 in the trabeculectomy group. The outcome measures were changes in intraocular pressure (IOP), number of glaucoma medications used, visual acuity changes, success rate (IOP reduction ≥20% from the baseline or IOP between 6 and 21 mmHg, without further glaucoma surgery), complications, and revisional procedures. Kaplan-Meier survival analyses were performed for estimated survival time and compared.

Results: According to the final visit evaluations, the mean IOP decreased by 13.47 mmHg (52.1%) in the GATT group and by 16.69 mmHg (56.4%) in the trabeculectomy group. The mean IOP reduction did not significantly differ between the GATT and trabeculectomy groups (p>0.05). The number of failed eyes was 4 (23.5%) in the GATT group and 5 (26.3%) in the trabeculectomy group (p>0.05). The estimated failure times were 18.02±2.57 months for the GATT group and 37.92±7.79 months for the trabeculectomy group (p>0.05). In both groups, the number of glaucoma medications decreased significantly (p = 0.002 for the GATT group, p = 0.01 for the trabeculectomy group).The median time to first glaucoma medication use after surgery was 1.0 (0.5) month for the GATT group and 3.0 (11.0) months for the trabeculectomy group (p=0.001).

Conclusion: Both GATT and trabeculectomy effectively reduced the IOP and medication burden in pseudophakic eyes with PXG.

Keywords: Trabeculectomy, gonioscopy-assisted transluminal trabeculotomy, intraocular pressure, pseudoexfoliative glaucoma, pseudophakia.

INTRODUCTION

Cataract and glaucoma are both common ocular conditions with an increasing incidence with aging, and they frequently coexist. There are different surgical approaches in the management of patients with glaucoma and cataracts, which can be combined or sequential, i.e., first glaucoma surgery and then cataract extraction, or vice versa.[1] There is some evidence in the literature indicating the positive effects of cataract surgery on intraocular pressure (IOP)[2,3] and negative effects of cataract surgery on IOP control in eyes with pseudoexfoliative glaucoma (PXG) on which trabeculectomy has been performed.[4] For this reason, some surgeons prefer to plan cataract surgery first and glaucoma surgery subsequently, if needed.

PXG is the most common secondary open angle glaucoma and has a poorer prognosis than primary open angle glaucoma (POAG), rapid progression, more central and deeper visual field (VF) losses, lesser glaucoma medication responsiveness, and a greater risk of trabeculectomy failures, albeit higher IOP levels[5,6]. Cataract is a common

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condition associated with PXG, which involves certain surgical difficulties, such as zonular dehiscence and poor pupil dilatation.[6-8] Therefore, some surgeons prefer early cataract extraction in patients with PXG.

In the surgical treatment of glaucoma, filtrating procedures, including tube surgery and trabeculectomy, as well as minimally invasive glaucoma surgery (MIGS) are among the commonly used current options.[9] Trabeculectomy, the most commonly applied surgical method for the treatment of glaucoma across the world, is an ab externo procedure in which the subconjunctival drainage of the aqueous humor through sclerostomy and scleral flap helps IOP control. On the other hand, most MIGS procedures involve conjunctiva- and sclera-sparing ab interno approaches. Gonioscopy-assisted transluminal trabeculotomy (GATT), first described by Grover et al. in 2014, is one of the most popular MIGS techniques in which the unfunctional trabeculum is circumferentially bypassed using a Prolene suture or catheter, and the easy access of the aqueous humor to collector channels helps IOP control.[10] Recent studies have shown that GATT achieves good IOP control with high surgical success rates and a good safety profile.[11-13]

However, the long-term outcomes of GATT are lacking.

In the literature, there are some reports in which eyes that have undergone prior cataract extraction have been shown to be at greater risk for trabeculectomy failure than phakic eyes.[14]Additionally, trabeculectomy has a higher failure rate in PXG than in POAG.[15-17] On the other hand, recent publications have reported promisingly higher success rates for MIGS in patients with PXG than in those with POAG.[18,19] In a recent report, the surgical outcomes of GATT were determined to be similar in phakic and pseudophakic eyes.[20]

In order to help clinicians decide which surgical option is better for pseudophakic eyes with PXG, we decided to analyze the surgical outcomes of GATT and trabeculectomy in pseudophakic eyes with moderate to severe PXG.

MATERIALS AND METHODS

This is a retrospective case-control study conducted between January 2019 and December 2022 in a single tertiary eye center. The study was approved by the local ethics committee (registration number: HNEAH-KAEK-2022/243-4001) and followed the rules of the Declaration of Helsinki and its recent revisions.

Patient files were reviewed, and all patients with pseudophakic PXG who underwent either trabeculectomy or GATT without prior glaucoma surgery were included in the study.

Inclusion criteria:

- Pseudoexfoliative and pseudophakic glaucomatous eyes
- Visual field scores lower than -6 dB
- Follow-up of at least six months after surgery
- Available preoperative, operative, and postoperative patient data
- 180-degree or above goniotomy for the GATT group

Exclusion criteria:

- Follow-up duration of less than six months
- Visual field scores outside the limits specified in the inclusion criteria
- Lower than 180-degree of goniotomy for the GATT group
- History of previous glaucoma surgery or laser procedure
- Presence of any intraocular inflammatory disease, diabetic retinopathy, or maculopathy, or a history of intraocular surgery, such keratoplasty, vitrectomy, and scleral-fixated lens implantation

Surgical technique

GATT

All GATT operations were performed by a single experienced glaucoma surgeon (S.I.) using modified Swan Jacob lenses (Ocular Instruments, Bellevue, WA, USA). With the patient under subtenon, retrobulbar, or general anesthesia, the head was turned away from the surgeon while the operating microscope eyepiece was tilted 60 degrees in the direction of the surgeon. Two anterior chamber entry ports were then formed temporally, one for the suture and the other for 23-G vitreoretinal forceps. First, a 2-2.5-mm goniotomy was performed with a 23-Gauge non-bent MVR knife. Then, with viscoelastic devices containing 1.4 sodium hyaluronate, under gonioscopic visualization, the heat-blunted 6/0 Prolene suture was advanced through the Schlemm canal by repeatedly grasping, pushing, and re-grasping cycles with 23-G vitreoretinal forceps. When the distal end of the suture was seen on the goniotomy aperture, a 360-degree goniotomy was achieved by gently pulling the two ends of the suture together. In the case of unsuccessful 360-degree advancement through the canal, one proximal end of the suture was pulled, and the degree of goniotomy achieved was noted based on angle hemorrhage. At the end of surgery, intracameral

cefuroxime, triamcinolone acetonide, and air bubbles were administered to control postoperative inflammation and hemorrhage. In the postoperative period, the patients were prescribed antibiotic drops for two weeks and prednisolone drops for 1-1.5 months.

Trabeculectomy

All trabeculectomies were performed by a single experienced glaucoma surgeon (S.I.). Using a fornix-based approach, 0.04 mg/ml of mitomycin-C was applied subconjuctivally for three minutes. After meticulous rinsing of mitomycin-C, flap with a 2x3 mm width and 2/3 of scleral thickness was created. By excising approximately 0.5x2-mm sclerocorneal tissue, the anterior chamber was accessed. Following iridectomy, the flap corners were tightly sutured using 10-0 nylon sutures. After controlling filtration, additional sutures were applied if there was excessive filtration. The conjunctiva was sutured to the cornea using diagonal mattress sutures. Subconjunctival dexamethasone and gentamycin were applied at the end of the procedures. In the postoperative period, the patients were prescribed two months of steroid treatment, two weeks of antibiotic drops, and one week of cycloplegia.

Outcome measures

Data on demographics, baseline clinical characteristics, follow-up durations, preoperative and last visit glaucoma medications, and baseline and postoperative (first day, first week, first month, sixth month, first year, second year, and last visit) IOP measurements were obtained from the patients' medical records. Surgical success was defined as an IOP of <21 mmHg or at least a 20% IOP reduction without further glaucoma surgery. Surgical success ratios, IOP decrease from the baseline to the last visit, number of glaucoma medications, and best-corrected visual acuity (BCVA) changes from the baseline to the last visit were compared between the two groups. The Kaplan–Meier survival analysis was conducted to evaluate the surgical success rates.

STATISTICAL METHOD

The data were analyzed using the statistical package program of IBM SPSS Statistics Standard Concurrent User, v 26 (IBM Corp., Armonk, New York, USA). Descriptive statistics were given as number (n), percentage (%), mean, standard deviation, standard error, median, and interquartile range values. The distribution of numerical variables was evaluated with the Shapiro-Wilk test of normality. The homogeneity of variances was evaluated with Levene's test. Comparisons between groups for numerical variables were made with the t-test for independent samples if the data were normally distributed, and with the Mann-Whitney U test if the data were not normally distributed. The chi-square test was used to compare groups for categorical variables. The intragroup comparisons of the number of glaucoma medications used were undertaken using the Wilcoxon test. The two-way analysis of variance was used in repeated measurements to compare the preoperative and postoperative logMAR values according to groups. In the comparison of IOP values according to groups, the comparisons were made with the linear mixed model due to missing data at some of the measurement times. The two-way analysis of variance in repeated measurements and the Bonferroni correction were applied in pairwise comparisons based on the linear mixed model analysis. The Kaplan-Meier analysis and log-rank (Mantel-Cox) tests were used to compare the failure times of the groups. A p value of <0.05 was considered statistically significant.

RESULTS

Groups and baseline characteristics

A total of 36 eyes of 36 patients, 17 in the GATT group and 19 in the trabeculectomy group, were included in the study, and the group characteristics are shown in Table 1. The mean age was 72.4 ± 7.6 years in the GATT group and 72.1 ± 7.8 years in the trabeculectomy group ($p > 0.05$). The number of male patients was 10 (58.8%) in the GATT group and 14 (73.7%) in the trabeculectomy group ($p > 0.05$). There was no statistically significant difference between the groups in terms of the cup-to-disc ratio, mean deviation, central corneal thickness, and laterality distributions. The median degree of cannulation for GATT was 270 (180) degrees. The median follow-up time was 7 (13) months in the GATT group and 12 (42) months in the trabeculectomy group ($p > 0.05$).

Surgical success

The number of eyes with surgical failure was 4 (23.5%) in the GATT group and 5 (26.3%) in the trabeculectomy group ($p > 0.05$) (Table 1). The median time to failure was 6 months in the GATT group and 12 months in the trabeculectomy group. The difference between the failure times of the groups was not statistically significant. The Kaplan-Meier analysis showed that the mean estimated failure time was 18.02 ± 2.57 months for the GATT group and 37.92 ± 7.79 months for the trabeculectomy group,

Table 1: *Comparisons of the demographic and clinical characteristics of the groups*				
	Groups		**Test statistics**	
	GATT *n* = 17	Trabeculectomy *n* = 19	Test value	*p* value
Age, years	72.4 ± 7.6	72.1 ± 7.8	0.142	0.888†
Sex, *n* (%)				
Female	7 (41.2)	5 (26.3)	0.892	0.483‡
Male	10 (58.8)	14 (73.7)		
MD (dB)	-16.81 ± 4.6	-18.12 ± 3.5	0,210	0,134†
CDR	0.817 ± 0.177	0.894 ± 0.117	1.550	0.130†
CCT (µ)	546.5 ± 29.5	545.6 ± 23.0	0.080	0.937†
Laterality, *n* (%)				
Right	8 (47.1)	9 (47.4)	0.001	>0.999‡
Left	9 (52.9)	10 (52.6)		
GATT degree	270 (180)			
Follow-up (months)	7.0 (13.0)	12.0 (42.0)	1.745	0.087&
Surgical outcome, *n* (%)				
Success	13 (76.5)	14 (73.7)	0.037	>0.999
Failure	4 (23.5)	5 (26.3)		
Time to failure (months)	6.0 (6.0)	12.0 (28.0)	1.892	0.066&

n: patient number, %: column percentage. Numerical data are given as mean ± standard deviation or median (interquartile range) values, †: Independent-samples *t*-test, ‡: Chi-square test, &: Mann-Whitney U test
Abbreviations: GATT: gonioscopy-assisted transluminal trabeculotomy, CDR: cup-to-disc ratio, CCT: central corneal thickness

indicating no statistically significant difference (p = 0.267, log-rank test). The Kaplan-Meier survival curves of the two groups are shown in Figure 1.

Among the eyes with surgical success, eight (47.1%) from the GATT group and eight (42.1%) from the trabeculectomy group were not using any glaucoma medication. The median time to the first glaucoma medication was 1.0 (0.5) month for the GATT group and 3.0 (11.0) months for the trabeculectomy group (p = 0.001).

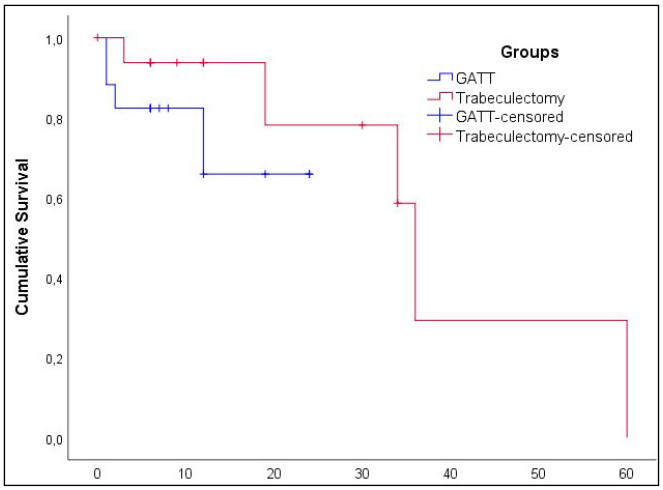

Figure 1: *Kaplan-Meier survival curves of the gonioscopy-assisted transluminal trabeculotomy and trabeculectomy groups*

IOP change

Table 2 and Figure 2 present the mean IOP values measured at different times. The mean IOP values of the GATT and trabeculectomy groups were 25.82 ± 1.84 mmHg and 29.58 ± 1.74 mmHg, respectively, at the preoperative evaluation, and 12.35 ± 1.16 mmHg and 12.89 ± 1.09 mmHg, respectively, at the last visit. The IOP reduction from the baseline to the last visit was 13.47 (52.1%) in the GATT group and 16.69 (56.4%) mmHg in the trabeculectomy group, being statistically significant for both groups (p < 0.001). There was no statistically significant difference in the inter-group analysis of the groups in terms of the median IOP values obtained at any measurement time (p > 0.05 for all).

Medications and BCVA

There was no statistically significant difference between the two groups in relation to the number of preoperative and postoperative glaucoma medications used (p = 0.594

Table 2: *Comparison of the IOP values within and between the groups over time**

	Groups				Test statistics†	
	GATT		Trabeculectomy		Test value	*p* value
	n	*IOP (mmHg)*	*n*	*IOP (mmHg)*		
Preop	17	25.82 ± 1.84	19	29.58 ± 1.74	2.203	0.147
Postop day 1	17	12.94 ± 1.82	19	11.84 ± 1.72	0.193	0.664
Postop week 1	16	15.55 ± 2.25	19	11.47 ± 2.10	1.754	0.194
Postop month 1	17	16.18 ± 1.98	19	12.32 ± 1.87	2.015	0.165
Postop month 6	17	12.82 ± 1.37	19	13.53 ± 1.30	0.138	0.712
Postop year 1	7	12.50 ± 1.40	13	14.08 ± 1.13	0.763	0.392
Postop year 2	5	13.40 ± 1.71	9	14.40 ± 1.50	0.191	0.667
Last visit	17	12.35 ± 1.16	19	12.89 ± 1.09	0.116	0.736
Test statistics‡	$F = 6.459$; $p < 0.001$		$F = 13.146$; $p < 0.001$			

*Linear mixed models; data are given as mean ± standard error. †comparisons between groups, ‡comparisons within groups. Abbreviations: GATT: gonioscopy-assisted transluminal trabeculotomy, n: number of measured eyes, IOP: intraocular pressure, preop: preoperative, postop: postoperative

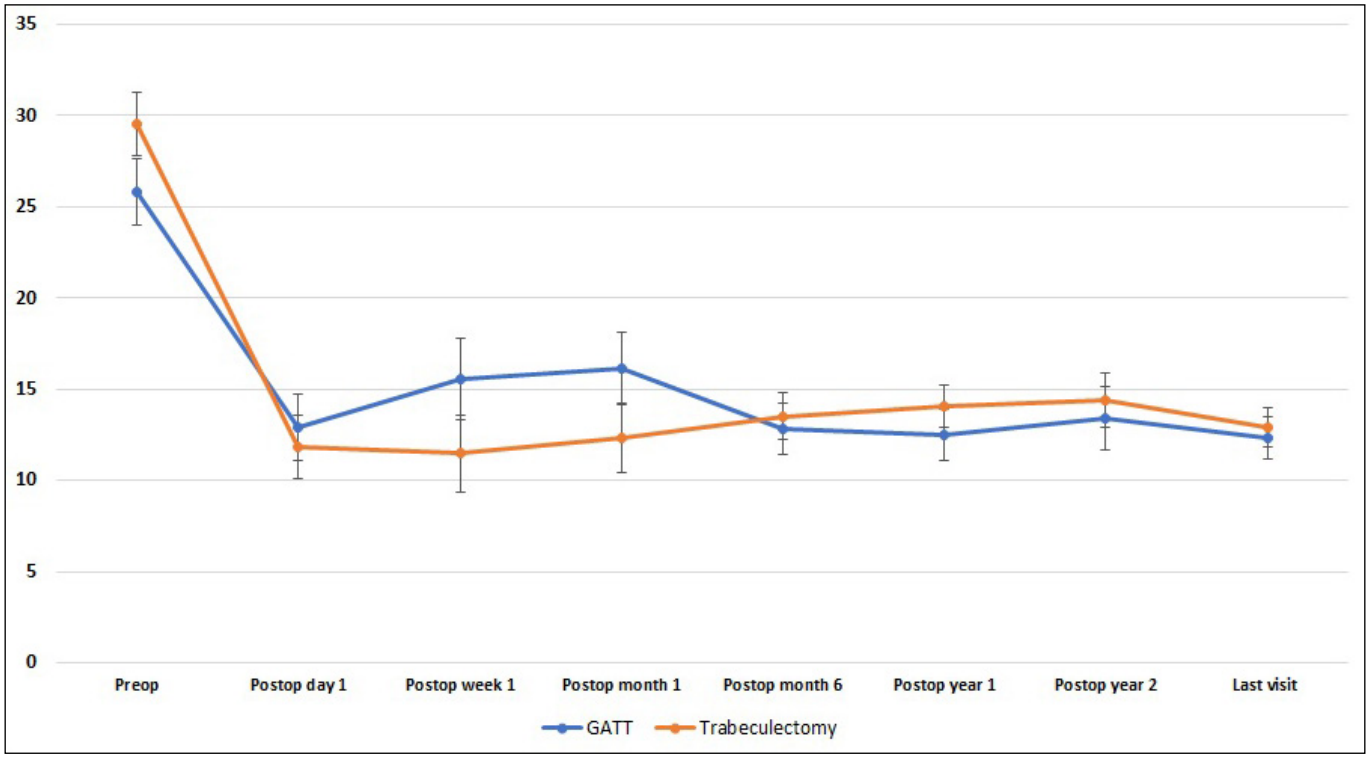

Figure 2: *Intraocular pressure change curves of the gonioscopy-assisted transluminal trabeculotomy and trabeculectomy groups*

and p = 0.707, respectively). According to the intra-group comparisons, there was a statistically significant decrease in the number of medications used in both groups in the postoperative period compared to the baseline (p = 0.002 for the GATT group and p < 0.001 for the trabeculectomy group). However, the amount of decrease in the number of medications did not statistically significantly differ between the groups (p = 0.876) (Table 3).

The comparisons of the BCVA values between the groups showed no statistically significant difference in the preoperative or postoperative logMAR values of the groups (p = 0.840 and p = 0.138, respectively). According to the intra-group comparisons, the postoperative and preoperative values of the GATT group did not significantly differ (p = 0.327), while the mean postoperative value was statistically significantly higher than the preoperative value in the trabeculectomy group (p = 0.020) (Table 3).

Table 3: *Comparison of preoperative and postoperative glaucoma medication use and logMAR values*

	Groups		Test statistics†	
	GATT $n = 17$	Trabeculectomy $n = 19$	Test value	*p* value
Glaucoma medication				
Preop	4.0 (1.0)	4.0 (1.0)	0.614	0.594&
Postop	0.0 (2.0)	1.0 (2.0)	0.431	0.707&
Difference	3.0 (3.0)	3.0 (3.0)	0.164	0.876&
Test statisticsɣ	3.145; 0.002ɳ	3.654; <0.001ɳ		
LogMAR				
Preop	1.00 ± 1.11	1.07 ± 0.13	0.041	0.840†
Postop	0.82 ± 1.15	1.45 ± 1.23	2.314	0.138†
Difference	0.17 ± 0.30	-0.38 ± 0.85	**5.619**	**0.024**†
Test statisticsɣ	0.990; 0.327†	**5.996; 0.020**†		

Numerical data are given as mean ± standard deviation or median (interquartile range) values. †comparisons between groups, ɣcomparisons within groups, ɳWilcoxon test, †two-way repeated measures analysis of variance
Abbreviations: GATT: gonioscopy-assisted transluminal trabeculotomy, preop: preoperative, postop: postoperative

Complications and additional procedures

Among the intraoperative complications, conjunctival dehiscence was noted in three patients in the trabeculectomy group, and gross-angle hemorrhage was noted in one patient in the GATT group.

As a postoperative complication, hyphema occurred in two patients in the GATT group. In the trabeculectomy group, corneal edema was observed in two patients, Seidel positivity in one patient, hyphema in three patients, and early postoperative endophthalmitis in one patient.

None of the patients in the GATT group required any revisional procedure, whereas in the trabeculectomy group, Argon laser suturolysis was performed on four patients, bleb needling on three patients, and bleb revision on three patients.

Additional glaucoma surgery was required in four eyes in the GATT group [trabeculectomy in three and Ahmed glaucoma valve (AGV) implantation in one] and four eyes in the trabeculectomy group (all AGV implantation).

DISCUSSION

In the current study, we determined the surgical success rates of the GATT and trabeculectomy groups to be 76.5% and 73.7% over the median follow-up durations of 7.0 (13.0) months and 12.0 (42.0) months, respectively. In the Kaplan-Meier analysis, we did not detect any statistically significant difference in the failure times of the groups. The IOP decreased from 25.82 ± 1.84 mmHg preoperatively to 12.35 ± 1.16 mmHg (52.1%) after GATT and from 29.58 ± 1.74 mmHg to 12.89±1.09 mm Hg (56.4%) after trabeculectomy, according to the last visit measurements. While the reduction in IOP was statistically significant for both groups ($p < 0.001$ for both), there was no significant difference between the groups in terms of the preoperative IOP or the values measured during the postoperative control visits. The IOP levels at the first postoperative month tended to be higher in the GATT group, albeit without any significant difference. The higher IOP level of this group may be related to the postoperative IOP spikes that are commonly seen after GATT surgery due to retained viscoelastic material, red blood cells clogging the distal outflow pathways, or steroid responsiveness.[21] In a meta-analysis, the combined IOP reduction was determined to be 9.8 mmHg (95% confidence interval: 7.98-11.63 mmHg), and the pooled success rate was found to be 85%. The authors concluded that GATT was a safe and effective method for the treatment of open angle glaucoma.[13] Although the mean IOP reduction values in both the GATT and trabeculectomy groups in our study were higher than those reported in the previous meta-analysis, we detected lower success rates. The reason may be related to the low baseline IOP levels of the subjects included in the studies covered by the meta-analysis which were not clear and the floor effect and episcleral venous pressure probably limiting further IOP reduction. Although our patient number was not very high, we can suggest that pseudophakic eyes with PXG tend to have lower success

rates, regardless of whether the surgical method is GATT or trabeculectomy.

In a recent study, Aktas et al.[22] evaluated the outcomes of GATT in eyes with POAG and PXG and determined that the mean IOP decreased by 8.8 mmHg (34.4%) in the POAG group and by 12.8 mmHg (44.6%) in the PXG group. In the same report, cumulative success probability during the first year was significantly higher in the PXG group (97.6%) than in the POAG group (86.8%) ($p = 0.01$), but no significant difference was found after two years ($p = 0.07$). The authors concluded that GATT was safe and effective in reducing the IOP and medication burden in patients with POAG and PXG. In the same study, a significantly higher success rate was noted in the PXG group compared to the POAG group in the first year after GATT; however, in subsequent years, the success rates of the two groups were similar. In the subgroup analysis, the authors detected partial GATT (trabeculotomy less than 360 degrees) as successful as complete GATT. In the same report, the authors evaluated GATT as a standalone procedure or combined with cataract extraction in phakic eyes, and GATT in pseudophakic eyes and reported the cumulative probability of success to be 86.9%, 75%, and 72.9%, respectively, for patients with PXG. Although no statistically significant difference was observed in the subgroup analysis, the success rate was lower for the pseudophakic eyes compared to the phakic eyes.

Another study investigated surgical outcomes in a total of 103 eyes with PXG, of which 50 underwent GATT combined with cataract extraction and 53 were pseudophakic.[20] The authors reported an IOP reduction of 51% and a success rate of 89% after 24 months of follow-up. They achieved 360-degree cannulation in 97 of the 103 eyes. There were no significant differences between the groups in terms of the reduction in IOP and glaucoma medications.

To the best of our knowledge, trabeculectomy is the most commonly performed filtrating surgery among glaucoma operations. Although it is very effective in reducing IOP, it is open to several sight-and eye-threatening complications, including hypotony, choroidal effusion or detachment, suprachoroidal hemorrhage, endophthalmitis, and loss of light perception.[9,23] In a retrospective cohort study, Landers et al.[16] found that eyes with pseudoexfoliation were more likely to progress to blindness. Furthermore, many studies have reported lower success rates for trabeculectomy in patients with PXG than those with POAG.[15] Takihara et al.[14] reported that among patients with open-angle glaucoma, trabeculectomy with mitomycin C after phacoemulsification for a target IOP of less than 21 mmHg or less than 18 mmHg was less successful in pseudophakic eyes than in phakic eyes. However, Torres-Costa et al.[24] found that previous clear-cornea phacoemulsification surgery did not lead to statistically significant differences in the rate of trabeculectomy failure.

As indicated by the findings reported in the literature, there are controversies concerning the effect of previous cataract surgeries on trabeculectomy failure. Some studies found decreased success rates or lesser IOP reduction in pseudophakic eyes, while others did not report any difference. A healthy conjunctiva and tenon tissue are important for bleb function. Therefore, any previous surgical intervention of the eye affecting the conjunctiva, such as cataract extraction, may aggravate the later healing process in trabeculectomy, and thus result in bleb dysfunction. Theoretically, since GATT is an ab interno procedure, it is probably influenced indirectly, and to a lesser extent, by previous operations affecting the conjunctival healing process. 360-degree GATT provides circumferential aqueous access to collector channels and the episcleral venous plexus. On the other hand, trabeculectomy provides sectoral access to the episcleral venous plexus via a functioning bleb. Thus, any abnormal healing process may have a greater impact on the bleb, which provides sectoral drainage, whereas the circumferential effect of localized conjunctival damage would be less in GATT. However, it should also be noted that with clear corneal incisions, the effect of previous cataract surgery on later conjunctival healing would be less. In our study, the success rates and IOP reduction did not differ between the GATT and trabeculectomy groups among the pseudophakic eyes with PXG.

In this study, there was no significant difference in the number of glaucoma medications used between the baseline and last visit in either group. The median number of molecules used decreased from 4 (1) preoperatively in both groups to 0 (2) in the GATT group and 1 (2) in the trabeculectomy group at the last visit. Among the eyes with surgical success, the rate of those free of glaucoma medication also did not show any statistically significant difference. However, the time from surgery to the first glaucoma medication use was significantly shorter in the GATT group.

The preoperative and last visit BCVA levels did not significantly differ between our GATT and trabeculectomy groups. However, according to the intra-group comparisons, while the logMaR value obtained at the last visit was not

statistically significantly different from the preoperative value in the GATT group, it was significantly higher than the preoperative value in the trabeculectomy group. This means a significant decrease in visual acuity, which may be related to the higher complication rate and intervention requirements in the trabeculectomy group.

As also observed in our study, the postoperative care and healing processes following trabeculectomy require special attention and sometimes revisional procedures, such as Argon laser suturolysis, bleb needling, and open surgical bleb revision. In our sample, Argon laser suturolysis was performed on four patients, needling with antimetabolites on three, and open bleb revision on three. On the other hand, no additional postoperative procedures were required in any of the patients in the GATT group. This means faster recovery, fewer hospital visits, and lesser work loss for patients who have undergone GATT. Although trabeculectomy remains the gold standard method for the surgical treatment of glaucoma, GATT seems to be on the way to proving to be an effective and safe option for glaucoma surgery, with the advantage of offering faster recovery.

In our study, 360-degree cannulation was achieved in eight patients, and the degree of trabeculotomy was between 180 and 360 degrees, with a median of 270 degrees, depending on angle visualization and appearance of angle hemorrhage. Aktas et al.[22] reported that the trabeculotomy degree was not a significant factor for surgical success. Due to our limited patient number, we were not able to analyze the effect of the degree of trabeculotomy tear on surgical success. However, we know from the results of trabectome surgery (Neomedix Corp., Tustin, CA, USA), which provides approximately 60-120 degree trabeculotomy, that this degree range offers effective reduction in IOP.[18,25]

Our study has certain limitations. First, our study design was retrospective, and the indications for the two surgical techniques were not randomized. However, we tried to overcome this limitation by forming the trabeculectomy group with age- and sex-matched cases at a similar glaucomatous stage with similar glaucoma medication usage. The second limitation concerns the low number of patients. Since we specifically aimed to determine the surgical outcomes of pseudophakic eyes with PXG in the moderate to severe glaucoma stage, we could not reach a very high sample size. We consider that our major limitation is related to the shorter follow-up time for patients who underwent GATT. Compared to trabeculectomy, GATT is a relatively new technique but has promising surgical results, and an increasing number of surgeons are applying this method. We will be able to comment further on GATT and its safety and efficacy over time. Lastly, we were not able to achieve 360-degree cannulation in all patients, and thus different cannulation degrees may have affected our results.

To the best of our knowledge, this is the first study to compare the surgical outcomes of GATT and trabeculectomy in pseudophakic eyes with PXG. Although our follow-up time was not long (mean, 7.0 (13.0) months), we found that GATT had a comparable success rate to trabeculectomy in eyes with moderate to severe glaucoma. Apart from combining GATT with phacoemulsification surgery in the PXG, GATT may also be a surgical option for pseudoexfoliative pseudophakic eyes and presents some further advantages, such as faster recovery and fewer additional procedure requirements. Moreover, since GATT is an ab interno procedure that preserves the conjunctiva and sclera, it probably has no negative effect on future trabeculectomy surgery.

In conclusion, GATT and trabeculectomy had comparable IOP reduction and surgical success rates in the surgical management of pseudophakic eyes with PXG. In the GATT group, postoperative medication use started earlier, while after trabeculectomy, revisional procedures were frequently needed and BCVA decreased significantly. In light of our results, we can conclude that GATT is a safe procedure with a lower further intervention requirement and comparable efficacy to trabeculectomy. However, further randomized prospective studies with larger cohorts are needed to support our results.

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