

Comparison of long-term results of trabeculectomy to treat pseudoexfoliative glaucoma and primary open angle glaucoma

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Abstract

• **AIM:** To compare the long term outcome of trabeculectomy in patients with pseudoexfoliative glaucoma (PEG) and primary open angle glaucoma (POAG) in terms of surgical success.

• **METHODS:** The success of the trabeculectomy was evaluated by three criteria. **Criterion A:** intraocular pressure (IOP) ≤ 21 mm Hg and decrease in IOP $\geq 20\%$; **Criterion B:** IOP ≤ 18 mm Hg and decrease in IOP $\geq 30\%$; **Criterion C:** IOP ≤ 15 mm Hg and decrease in IOP $\geq 50\%$. Patients that met these criteria without medical treatment were considered to be completely successful, while those that met these criteria with medical treatment were considered partially successful. Significance levels of differences between the POAG and PEG groups in the Kaplan-Meier survival curves were calculated with the log-rank test.

• **RESULTS:** Sixty-four eyes from 64 patients with PEG and 51 eyes from 51 patients with POAG were evaluated. No significant differences were detected between the PEG and POAG groups according to full or partial success relative to each of the three criteria (A: $P=0.73, 0.32$; B: $P=0.73, 0.31$; C: $P=0.90, 0.27$).

• **CONCLUSION:** There is no difference in the long-term success of trabeculectomy between PEG and POAG patients whose clinical characteristics are otherwise the same.

• **KEYWORDS:** primary open angle glaucoma; pseudoexfoliative glaucoma; trabeculectomy success

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INTRODUCTION

Pseudoexfoliative glaucoma (PEG) is the most common type of secondary open angle glaucoma^[1-2]. The clinical signs of PEG are well known. This type of glaucoma is more aggressive than primary open angle glaucoma (POAG); intraocular pressure (IOP) is higher, IOP fluctuations are excessive, and there is substantial damage to the optic nerve and visual field^[3-4]. Moreover, PEG has a limited response to medical treatment^[5]. In addition to these clinical differences, vasculopathy of the iris and disruption of the blood-aqueous barrier may cause postoperative fibrin exudation, and microneovascularization of the iris may cause intraoperative and late-onset hyphema^[6-8]. Variations in this condition's course and response to medical treatment suggest that response to surgical treatment may also vary.

Some studies have compared the success of trabeculectomy to treat PEG and POAG. Ehnrooth *et al*^[9] investigated immediate and mean 4y follow-up outcomes after trabeculectomy and reported lower success in PEG patients. However, Serguhn and Spiegel^[10] found no differences with respect to surgical success in patients with PEG or POAG, while Törnqvist and Drolsum^[11] reported high success in PEG patients during a long-term follow-up period.

Although the results in the literature vary, IOP < 21 mm Hg was considered to indicate a successful procedure^[7-10]. However, this is currently considered to be a rather high pressure for patients who have undergone trabeculectomy, and it is also higher than the target IOP. Thus, whether this IOP value truly indicates a successful procedure is subject to debate.

The purpose of this study was to compare the long-term results of trabeculectomy in PEG and POAG patients with respect to three different success criteria.

SUBJECTS AND METHODS

We retrospectively analyzed the records of patients who underwent primary trabeculectomy in the Trakya University Ophthalmology Department in 1993-2013. Patients diagnosed with PEG and POAG who had no additional glaucoma surgery

Table 1 Clinical characteristics of patients with PEG and POAG

Parameters	PEG (n=64)	POAG (n=51)	P
Mean age (a)	68±9	62± 9	0.49 ^a
Gender	13 (46.4)	5 (41.7)	1.00 ^b
Preoperative IOP (mm Hg)	23±4	22±5	0.75 ^c
Duration of preoperative medical treatment (mo)	30±40	38±43	0.03 ^c
First postoperative IOP (mm Hg)	13±9	11±7	0.47 ^c
Initiation of medical treatment in postoperative period (mo)	18±31	22±30	0.07 ^c
Final IOP (mm Hg)	14±5	15±3	0.01 ^c
Follow-up time (mo)	81±56 (12-254)	94±54 (24-256)	0.11 ^c

^aIndependent *t*-test; ^bChi-square test with Yates correction; ^cMann-Whitney *U* test. IOP: Intraocular pressure; PEG: Pseudoexfoliative glaucoma; POAG: Primary open angle glaucoma.

in the postoperative period, regular records, and were followed up for at least 24mo were included in the study. To definitively diagnose PEG, pseudoexfoliative material should be seen in the anterior segment, IOP should be >21 mm Hg, and typical glaucomatous visual field damage must be present^[1-2].

Patients with a history of cataract surgery or any other ocular surgery before trabeculectomy, ocular trauma, or any ocular disease other than glaucoma were excluded from the study. A total of 115 eyes from 115 patients matching the inclusion criteria were evaluated. One randomly selected eye was enrolled in the study for patients who underwent bilateral trabeculectomy.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study

Patients' data were examined for age at the time of trabeculectomy, gender, preoperative medical treatment and duration, and preoperative IOP measured by Goldmann applanation tonometer. Patients with high IOP despite the maximum tolerated medical therapy or ongoing glaucomatous damage underwent trabeculectomy. All operations were performed with the same technique. A limbus-based conjunctival flap was prepared, and then a 3×3 mm² half-scleral-thickness scleral flap was dissected up to the transparent cornea mitomycin-C (MMC) applied unnecessary cases under the conjunctiva. A 2×2 mm² trabecular block was removed with the help of a razor blade, and a peripheral iridectomy was performed. The scleral flap was sutured with 2-4 pieces of 10/0 nylon suture, and the conjunctiva was sutured with 8/0 vicryl suture. Postoperatively, topical cycloplegic agents, antibiotics, and steroid drops were applied to the patients. Postoperative needling and argon laser sutureless treatments were recorded. Postoperative 1d, 1, 3, 6mo, and 1y and later annual examination outcomes were evaluated. During follow-up, events in which glaucoma medication was added and cataract surgeries were performed

were also examined. Increased IOP despite medical treatment and requirements for a second glaucoma surgery were considered as "end of the follow-up period".

The success of the trabeculectomy was evaluated by three criteria: A) IOP ≤21 mm Hg and decrease in IOP ≥20%; B) IOP ≤18 mm Hg and decrease in IOP ≥30%; C) IOP ≤15 mm Hg and decrease in IOP ≥50%. Patients that met these criteria without medical treatment were considered to be "complete success", while those that met these criteria with medical treatment were considered "qualified success"^[12-14].

Statistical Analysis Normality distribution of the variables was tested by one sample Kolmogorov Smirnov test. The Students' *t*-test was used for normally distributed, and Mann-Whitney *U* test was used for non-normally distributed data. Also, categorical variable were compared by Chi-square (Yates of Fisher exact) tests. The Kaplan-Meier survival analysis was carried out to calculate survival curves, and Log-rank test was used for group comparisons (POAG vs PEG). *P*<0.05 was assumed significant for all analysis.

RESULTS

Sixty-four eyes from 64 patients with PEG and 51 eyes from 51 patients with POAG were included in the study. Fifty-six of the patients (48.7%) were males, and 59 of the patients (51.3%) were females. The mean age at the time of the trabeculectomy was 65±10y. There was no significant difference between PEG and POAG patients with respect to mean age, gender, mean preoperative IOP, mean postoperative first IOP values, initiation time of medical treatment in postoperative period, and follow-up time (*P*=0.49, 1.00, 0.75, 0.47, 0.07 and 0.11, respectively). However there was a significant difference between PEG and POAG patients with respect to duration of preoperative medical treatment and final IOP (*P*=0.03, 0.01) (Table 1). In addition, there was no significant difference between PEG and POAG patients with respect to number of cases preoperative MMC usage, postoperative needling, subconjunctival 5 fluorouracil injection, laser suture lysis and hypotony (*P*=0.68, 0.34, 0.36, 0.85, 0.87, respectively) (Table 2).

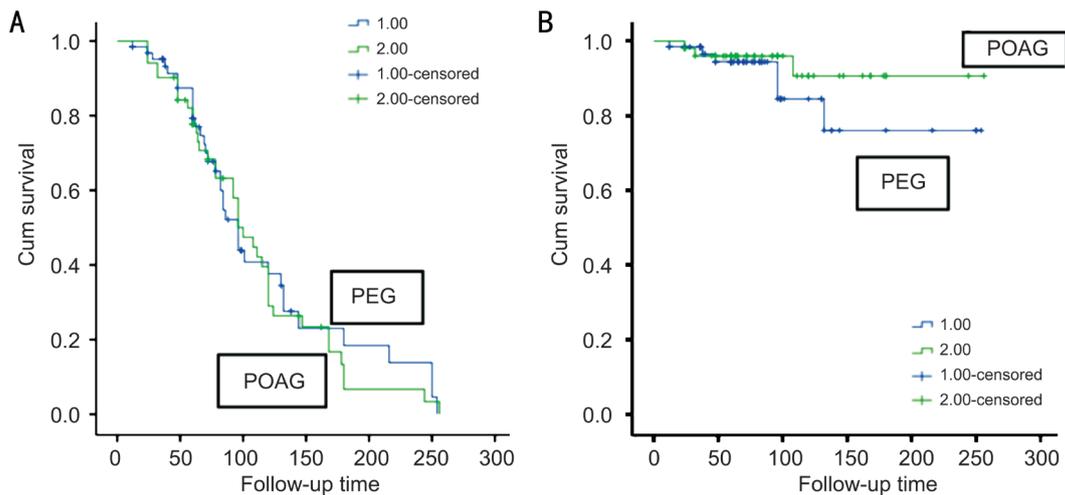


Figure 1 Kaplan-Meier survival analysis of full (A) and partial (B) success of trabeculectomy in patients according to criterion A in PEG and POAG groups.

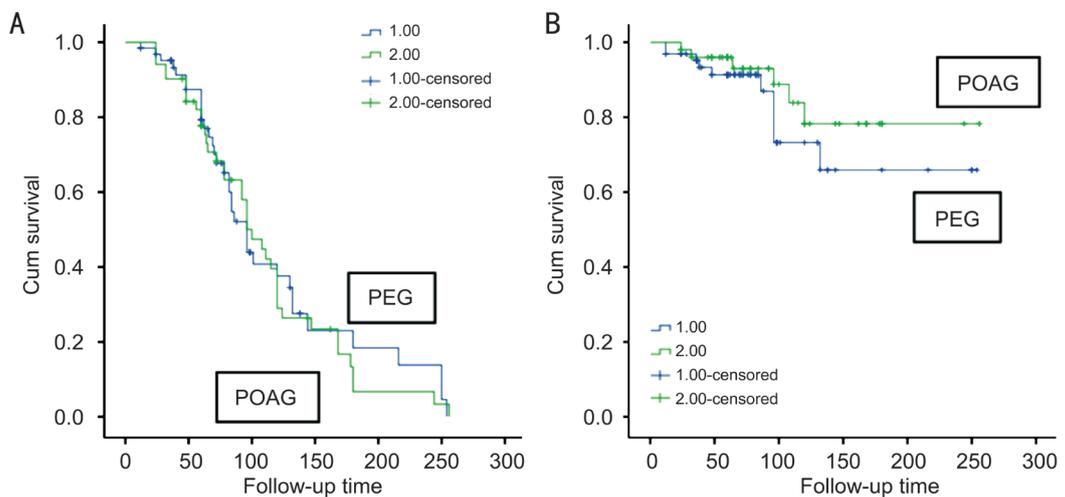


Figure 2 Kaplan-Meier survival analysis of full (A) and partial (B) success of trabeculectomy in patients according to criterion B in PEG and POAG groups.

Table 2 Perioperative and postoperative characteristics of patients with PEG and POAG

Parameters	PEG (n=64)	POAG (n=51)	¹ P
Peroperative MMC	17 (26.6)	11 (21.6)	0.68
Needling	14 (21.9)	16 (31.4)	0.34
Postoperative 5-FU	13 (20.3)	15 (29.4)	0.36
Laser suture lysis	14 (21.9)	11 (21.6%)	0.85
Postoperative hypotony	8 (12.5)	5 (9.8)	0.87

¹Chi-square test with Yates correction. MMC: Mitomycine C; 5-FU: 5 fluorouracil; PEG: Pseudoexfoliative glaucoma; POAG: Primary open angle glaucoma.

The number of with complete success that met criterion A was 28 (43.8%) in the PEG group and 12 (23.5%) in the POAG group. The number of complete success cases that met criterion B was 28 (43.8%) in the PEG group and 13 (25.5%) in the POAG group. The number of complete success cases that met criterion C was 24 (37.5%) in the PEG group and 10 (19.6%) in the POAG group (Table 3).

When we compared surgical success by the log-rank test between PEG and POAG groups with respect to criteria A-C, we found no significant differences in complete and qualified success between the two groups (Figures 1, 2 and 3; Table 4).

DISCUSSION

We investigated the long-term results of 115 eyes from 115 patients who underwent trabeculectomy for PEG or POAG. By 81±56 (min 12-max 254)mo post-trabeculectomy in the PEG group and 94±54 (min 24-max 256)mo post-trabeculectomy in the POAG group, according to our three criteria, there was no difference with respect to surgical success between the two groups.

Previous studies have compared the success of trabeculectomy to treat PEG and POAG. Mietz *et al*^[15] evaluated the trabeculectomy outcomes of 709 eyes from 506 patients with variable types of glaucoma at the end of a mean 27.9mo follow-up period. They concluded that there was no difference in surgical success between PEG and POAG cases.

Ehrnrooth *et al*^[9] compared the success of trabeculectomy in

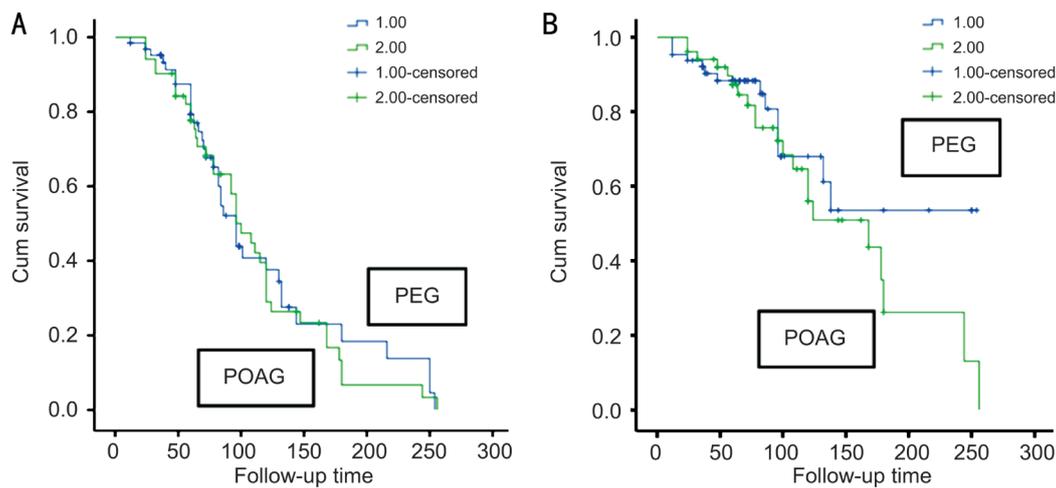


Figure 3 Kaplan-Meier survival analysis of full (A) and partial (B) success of trabeculectomy in patients according to criterion C in PEG and POAG groups.

Table 3 Complete and qualified success rates of trabeculectomy according to criteria A-C in patients with PEG or POAG n (%)

Condition	Criterion A		Criterion B		Criterion C	
	Complete success	Qualified success	Complete success	Qualified success	Complete success	Qualified success
PEG	28 (43.8)	58 (90.6)	28 (43.8)	54 (84.4)	24 (37.5)	50 (78.1)
POAG	12 (23.5)	48 (94.1)	13 (25.5)	45 (88.2)	10 (19.6)	30 (58.8)

PEG: pseudoexfoliative glaucoma; POAG: primary open angle glaucoma.

Table 4 Comparison of success of trabeculectomy between PEG and POAG groups ¹P

Criteria	Complete success	Qualified success
Criterion A	0.73	0.32
Criterion B	0.73	0.31
Criterion C	0.90	0.27

¹Log-rank test. PEG: Pseudoexfoliative glaucoma; POAG: Primary open angle glaucoma.

138 eyes (55 POAG cases and 83 PEG cases) after 2-5y of follow-up. They found a significantly higher rate of full success for patients with POAG and demonstrated that in patients with PEG, an IOP of >30 mm Hg in the early postoperative period had a negative impact on the success of trabeculectomy. However, in this study, the mean ages of patients, preoperative IOPs and differences between follow-up periods were not compared. In addition, patients who underwent additional surgery after trabeculectomy were not excluded from study. Törnqvist and Drolsum^[11] reported that in 43% of cases with POAG and 64% of patients with PEG, no additional treatment was required 10y after trabeculectomy. But Törnqvist and Drolsum^[11] have not done survival analysis for the statistical evaluation.

Fernández *et al*^[16] found surgical success rates of 99.3% at the end of 1y, 90.6% at the end of 5y, 76.7% at the end of 10y, 70.1% at the end of 15y, and 45.9% at the end of 20y in 956 eyes that had undergone trabeculectomy and been followed for 3-20y. This study included POAG, PEG, and primary angle-closure glaucoma (PACG) patients. In the full-success group,

PACG patients had the lowest surgical success. When the authors evaluated partial success in the first 5y period, they found no significant difference among the three glaucoma types with respect to surgical success, but they did find a significant difference after 10y for POAG and after 15y for PEG. The reason for differences in the success of trabeculectomy in patients with PEG and POAG may be due to variations in patient selection. In some of these studies, the mean ages of the patients were different. In addition, surgical techniques, success criteria and the follow-up period were quite variable in the studies.

Another important factor when determining the success of trabeculectomy is the follow-up period. Patients with a longer follow-up period have decreased surgical success. To the best of our knowledge, this has been the result of all studies that have investigated the success of trabeculectomy^[9,17-21].

Although the results of the studies were different, all of the studies used the same success criteria; namely, an IOP of <21 mm Hg without additional treatment was considered a full success, while the same IOP with medical treatment in the postoperative period was considered a partial success. However, in clinical practice, an IOP of ≤21 mm Hg in the eye with glaucoma is generally not considered to be an acceptable value. Most clinicians would prefer an IOP of <14 mm Hg in these cases. Of particular concern is the decreased thickness in the lamina cribrosa that may accompany PEG, which can make the eye more sensitive to pressure^[22]. The ideal way to determine surgical success is to consider the target IOP of each individual. However, this makes it difficult to perform statistical analyses. The solution may be to use more than one

criterion to evaluate success, which is why we evaluated IOP values according to three different success criteria.

In the literature, there are studies that compares PEG patients treatment outcomes other than trabeculectomy and POAG^[22-24]. Ting *et al*^[22], compared the results of ab interno trabeculectomy (by the trabectome technique) in 450 patients with POAG and 67 patients with PEG. At the end of 1y follow up period, better results were obtained in PEG group. In their study to evaluate the success of trabectome, Jordan *et al*^[23] did not find any difference for complete success between POAG and PEG group, but they detected statically significant increased qualified success in PEG group. In these studies to perform trabecular aspiration during trabectome application might be the reason of increased success in PEG group.

In summary, we found that there was no difference in the long-term success of trabeculectomy between PEG and POAG patients whose clinical characteristics are otherwise the same. The limitation of the study was that we were unable to investigate the presence of concomitant diabetes, vascular disease and presence of cataract. In our study, there were no significant differences in the mean age and follow-up periods of the PEG and POAG patients. Moreover, these patients had not had another ocular surgery, disease, or trauma prior to trabeculectomy, and this was the first trabeculectomy that they had undergone. There are some differences for clinical course and response to medical treatment between PEG and POAG group. Although, there is no difference for the success of trabeculectomy between two groups.

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