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Impact of Combined Trabeculectomy and Manual Small-Incision Cataract Surgery on Visual Recovery and IOP Control in PACG

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Abstract

Background: *Primary angle-closure glaucoma (PACG) and primary open-angle glaucoma (POAG) are major causes of irreversible blindness worldwide, often coexisting with visually significant cataract. Combined trabeculectomy and manual small-incision cataract surgery (MSICS) may simultaneously improve visual acuity and control intraocular pressure (IOP), yet data on outcomes in PACG patients remain limited, particularly in Bangladesh. This study aimed to evaluate visual recovery, IOP reduction, surgical success and postoperative complications following combined surgery in PACG and POAG patients.*

Methods: *This prospective, observational case-series study was conducted at Department of Ophthalmology, National Institute of Ophthalmology and Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh between July 2021 and June 2022. Eighty patients (42 PACG, 38 POAG) with visually significant cataract and uncontrolled IOP or intolerance to anti-glaucoma medications were enrolled. Preoperative assessment included visual acuity (converted to LogMAR) and IOP measurement. All patients underwent combined trabeculectomy with MSICS performed by fellowship-trained glaucoma surgeons. Postoperative follow-up occurred on day 1, day 7 and at 1, 3 and 6 months. Outcomes assessed included visual acuity, IOP reduction, surgical success (complete, qualified, failure) and complications.*

Results: *The mean age was 60.11 ± 8.8 years, with 51.2% males. Preoperatively, 63.8% of patients had IOP 21–30 mmHg. At six months, mean LogMAR acuity improved from 0.9325 ± 0.51724 to 0.2912 ± 0.43638 ($p < 0.001$) and mean IOP decreased by 16.64 ± 7.54 mmHg, with most patients achieving target IOP of 6–21 mmHg. Complete success was achieved in 43.8% of PACG and 45.0% of POAG patients, while qualified success occurred in 8.8% and 1.2%, respectively. The majority (72.5%) had no postoperative complications, with posterior capsular opacity being the most common (11.2%).*

Conclusion: *Combined trabeculectomy with MSICS is effective and safe for managing visually significant cataract in PACG and POAG, providing significant visual improvement, meaningful IOP reduction and low complication rates.*

Keywords: *Primary angle-closure glaucoma, primary open-angle glaucoma, trabeculectomy, small-incision cataract surgery, visual recovery, intraocular pressure.*

1. Introduction

Glaucoma is a leading cause of irreversible blindness worldwide, with primary open-angle glaucoma (POAG) and primary angle-closure glaucoma (PACG) being the most prevalent forms [1]. PACG is particularly common in Asian populations, including Bangladesh and is associated with rapid progression and higher risk of visual morbidity if left untreated [2, 3]. Elevated intraocular pressure (IOP) remains the most important modifiable risk factor in glaucoma and achieving adequate IOP control is critical for preventing optic nerve damage and visual field loss [4].

In addition, cataract frequently coexists with glaucoma, especially in older populations and

contributes significantly to visual impairment, often compounding the challenges in clinical management [3].

Surgical intervention is indicated in glaucoma patients with uncontrolled IOP despite maximal medical therapy, intolerance to medications, or poor compliance [4]. Trabeculectomy is considered the gold-standard glaucoma surgery for long-term IOP control, while cataract extraction is the definitive treatment for visually significant lens opacities [5]. Traditionally, these procedures have been performed separately; however, combined surgery offers the advantage of addressing both glaucoma and cataract in a single operative session, potentially improving patient compliance, reducing healthcare costs and facilitating earlier visual rehabilitation [6].

Manual small-incision cataract surgery (MSICS) is widely practiced in low- and middle-income countries, including Bangladesh, due to its cost-effectiveness, shorter learning curve and suitability for advanced cataracts [7]. When performed in combination with trabeculectomy, MSICS allows simultaneous removal of the lens and creation of a filtration pathway, which can deepen the anterior chamber and improve angle anatomy in PACG, thereby enhancing IOP reduction. Despite the theoretical advantages, evidence regarding the effectiveness and safety of combined trabeculectomy and MSICS, particularly in PACG patients, remains limited [8]. Previous studies have reported variable outcomes in terms of postoperative IOP control, visual recovery and complication rates, highlighting the need for further investigation in diverse patient populations [9]. Understanding the impact of combined surgery on both visual acuity and IOP control is crucial for optimizing patient management, counseling and surgical planning. In Bangladesh, where PACG is common and access to tertiary glaucoma care is limited, evidence from local populations can inform clinical practice and improve outcomes [10,11].

This study aimed to evaluate the visual recovery and IOP-lowering efficacy of combined trabeculectomy and MSICS in patients with PACG, while also providing comparative insights with POAG where applicable. The findings are expected to contribute to evidence-based guidelines for the surgical management of glaucoma with coexisting cataract in resource-constrained settings.

2. Methodology & Materials

This prospective, observational case-series study was conducted in the Department of Ophthalmology, National Institute of Ophthalmology and Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh, between July 2021 and June 2022, enrolling a total of 80 patients through purposive sampling based on predefined inclusion and exclusion criteria to assess the impact of combined trabeculectomy and manual small-incision cataract surgery (MSICS) on visual recovery and intraocular pressure (IOP) control. Patients with visually significant age-related cataract and either primary open-angle glaucoma (POAG) or primary angle-closure glaucoma (PACG), whose IOP was not controlled with maximum tolerated medical therapy, or who had allergy, intolerance, or poor compliance with anti-glaucoma medications, were included. Patients with secondary glaucoma associated with ocular or systemic abnormalities, a history of previous glaucoma surgery, or those planned for glaucoma procedures other than trabeculectomy were excluded, as were individuals with complicated, traumatic, secondary, hyper-mature, or subluxated cataracts, cataract with corneal opacity, posterior segment diseases such as diabetic retinopathy or age-related macular degeneration, or those planned for surgical techniques other than MSICS. Preoperative evaluation included assessment of visual acuity using the Snellen chart with later conversion to logMAR, measurement of IOP using Goldmann applanation tonometry, documentation of glaucoma type, prior surgeries, use of anti-glaucoma medications and ocular comorbidities, along with slit-lamp biomicroscopy using a +78D lens for optic nerve head evaluation and cataract grading. All surgeries were performed by fellowship-trained glaucoma surgeons following a standardized protocol consisting of peribulbar anesthesia, creation of a partial-thickness scleral tunnel extended into clear cornea, MSICS with PMMA intraocular lens implantation and trabeculectomy completed with mitomycin-C–assisted scleral flap construction and placement of releasable sutures, with all intra-operative events documented. Postoperative care included topical antibiotics and steroids with gradual tapering and additional treatments such as anti-glaucoma medications, cycloplegics, bleb massage, or further interventions depending on postoperative IOP and clinical findings. Follow-up examinations were conducted on day 1, day 7

and at 1, 3 and 6 months, during which best-corrected visual acuity (BCVA), IOP, bleb morphology, complications and additional procedures were recorded. Primary outcome measures included complete success, qualified success, failure, postoperative visual acuity changes and the need for further intervention. Data were entered into SPSS version 16 and analyzed using paired t-tests, with a significance threshold set at $p < 0.05$.

Ethical approval was obtained from the CEITC and BCPS review boards and written informed consent was collected from all participants.

3. RESULTS

Table 1. *Baseline Ocular Characteristics of Study Participants (n = 80)*

Characteristics		PACG	POAG	P Value
Sex	Male	18 (42.9%)	23 (60.5%)	0.088
	Female	24 (57.1%)	15 (39.5%)	
Age (years)	Mean age (SD)	59.02 ± 8.94	61.32 ± 8.69	0.249
	Range	38–75	44–82	
Visual Acuity	LogMAR VA	0.9571 ± 0.54466	0.9053 ± 0.49097	0.655
Pre-operative IOP	Mean IOP (mmHg)	29.90 ± 6.596	29.79 ± 5.951	0.935
Types of Cataract	Nuclear Sclerosis	34 (80.9%)	34 (89.5%)	0.332
	Cortical	2 (4.8%)	0 (0%)	
	Posterior Subcapsular	6 (14.3%)	4 (10.5%)	

Table 1 shows the study included 80 patients, with 42 diagnosed with PACG and 38 with POAG. The mean age of the study population was 60.11 ± 8.8 years, ranging from 35 to 85 years, with most patients in the 56–65 years (48.8%, n = 39) and 66–85 years (22.5%, n = 18) age groups. Overall, 51.2% (n = 41) were male and 48.8% (n = 39) were female. Among PACG patients, 24 were female and 18 were male, while in the POAG group, 23 were male and 15 were female. A majority of patients (85%, n = 68) presented with nuclear cataract of varying grades, while 12.5% (n = 10) had posterior subcapsular cataract. Over half of the patients (56.2%, n = 45) had systemic diseases, with hypertension being the most common (21.2%, n = 17), diabetes mellitus alone in 6.2% (n = 5) and both hypertension and diabetes in 17.5% (n = 14); 35 patients had no systemic diseases. No significant differences were observed between PACG and POAG groups in baseline ocular characteristics.

Table 2. *Baseline Intraocular Pressure (n = 80)*

IOP (mmHg)	n	%
21-30	51	63.8
31-40	26	32.5
41-50	3	3.8
Total	80	100

Table 2 presents the baseline intraocular pressure (IOP) distribution of the study population (n = 80) before undergoing combined trabeculectomy and MSICS. The majority of patients had moderately elevated IOP: 63.8% (n = 51) were within the 21–30 mmHg range. A substantial proportion, 32.5% (n = 26), had more severe elevation with IOP between 31–40 mmHg. Only 3.8% (n = 3) of cases showed very high pre-operative IOP in the 41–50 mmHg range.

Figure 1 illustrates the distribution of visual acuity outcomes six months after surgery, categorized into three standard vision ranges. The majority of patients (90.0%) achieved good visual recovery with postoperative acuity between 6/6 and 6/18. A smaller proportion (7.5%) fell within the 6/24 to 3/60 range, while only 2.5% of patients had vision poorer than 3/60 at six months. The improvement in vision is further supported by the change in mean LogMAR visual acuity. The mean pre-operative LogMAR was 0.9325 ± 0.51724, which improved significantly to 0.2912 ± 0.43638 post-operatively. A statistically significant difference was observed between pre- and post-operative visual acuity ($p < 0.001$).

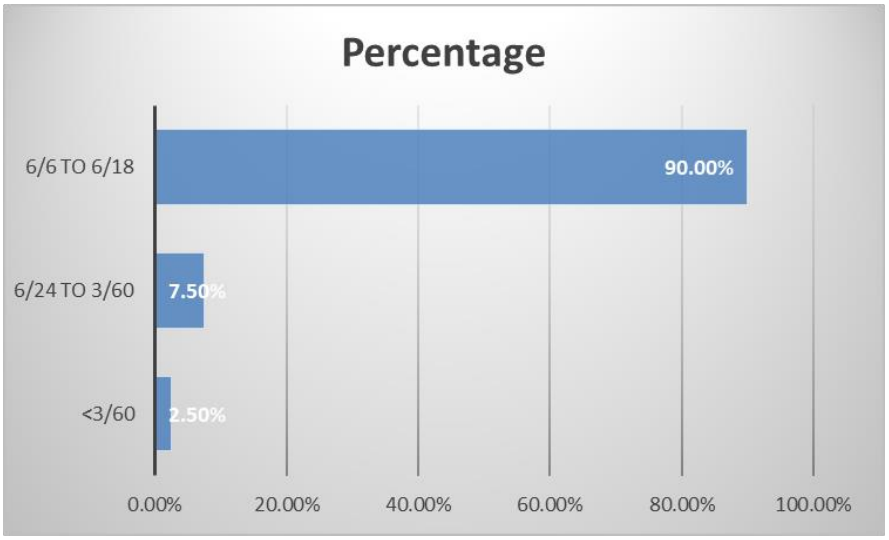

Figure 1. *Visual acuity 6 months after surgery in 3 category range.*

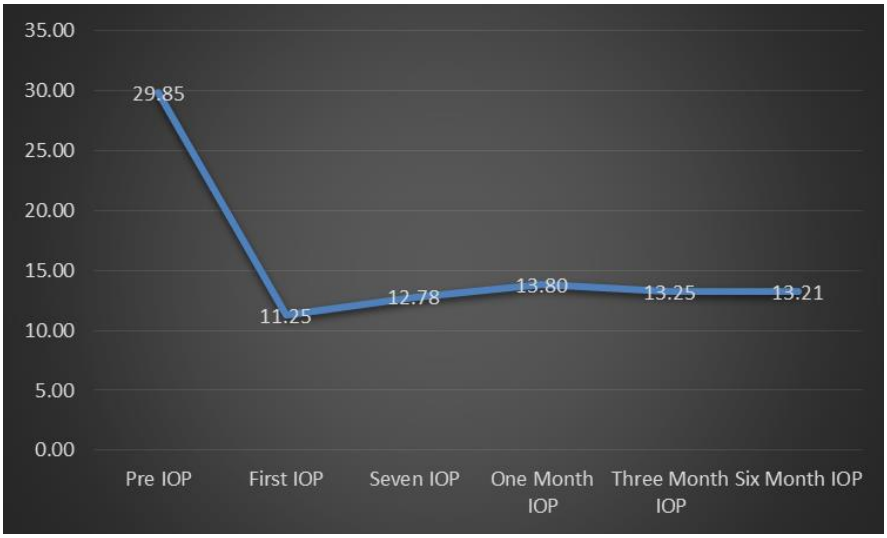

Figure 2. *Changes in Mean Intraocular Pressure (IOP) Before and Six Months After Surgery (n = 80)*

Mean intraocular pressure (IOP) was significantly reduced after combined trabeculectomy and manual small incision cataract surgery. The mean IOP reduction at six months post-operatively was 16.64 ± 7.54 mmHg. Post-operative IOP was further categorized into three ranges: <6 mmHg, 6–21 mmHg and >21 mmHg. The majority of patients achieved target IOP within the 6–21 mmHg range at all follow-up intervals (Figure 2).

Table 3. *Success Rate at 6 Months after Surgery in Different Types of Glaucoma (n = 80)*

Types of Glaucoma	PACG	POAG	Total
Complete Success	35	36	71
	43.80%	45.00%	88.80%
Qualified Success	7	1	8
	8.80%	1.20%	10.00%
Failure	0	1	1
	0%	1.20%	1.20%
Total	42	38	80

At six months post-operatively, complete success was achieved in 43.8% of PACG patients and 45.0% of POAG patients, while qualified success occurred in 8.8% of PACG and 1.2% of POAG patients. Only one patient (1.2%) experienced failure. Overall, POAG patients achieved slightly better IOP control compared to PACG patients. The lower complete success in PACG may be

attributed to factors such as younger age, shallower anterior chamber and a higher incidence of early post-operative complications in this group (Table 3).

Table 4. *Post-operative Complications (n = 80)*

Complications	N	%
No	58	72.5
PCO	9	11.2
Hyphaema	1	1.2
Vitreous hemorrhage	1	1.2
Late post-op uveitis	1	1.2
Cystic bleb	2	2.5
Severe post-op uveitis	1	1.2
IOL decentration	2	2.5
Iridodialysis	1	1.2
Wipe-out	1	1.2
Over-filtration	3	3.8
Total	80	100.0

Table 4 summarizes the distribution of post-operative complications among the study population (n = 80). The majority of patients (72.5%, n = 58) experienced no complications, indicating a generally favorable safety profile for combined trabeculectomy and MSICS. Among the reported complications, posterior capsular opacity (PCO) was the most common, occurring in 11.2% (n = 9) of cases. Less frequent events included over-filtration in 3.8% (n = 3), cystic bleb formation and IOL decentration each in 2.5% (n = 2) and several complications appearing in only 1.2% (n = 1) of patients, such as hyphaema, vitreous hemorrhage, late postoperative uveitis, severe uveitis, iridodialysis and wipe-out phenomenon.

4. Discussion

In this study, combined trabeculectomy and manual small-incision cataract surgery (MSICS) demonstrated significant improvements in both visual acuity and intraocular pressure (IOP) control in patients with primary angle-closure glaucoma (PACG) and primary open-angle glaucoma (POAG). The mean age of our study population was 60.11 ± 8.8 years, with a slight male predominance (51.2%), which aligns with previous reports suggesting that glaucoma prevalence increases with age and that gender distribution varies by subtype [12, 13]. Nuclear cataract was the predominant lens opacity in 85% of cases, consistent with findings from Khandelwal et al., who reported high rates of coexisting cataract in glaucoma patients [14].

Baseline IOP was moderately to severely elevated, with 63.8% of patients having 21–30 mmHg and 32.5% having 31–40 mmHg. Following combined surgery, mean IOP decreased by 16.64 ± 7.54 mmHg at six months, with most patients achieving target IOP in the 6–21 mmHg range. These results are comparable to prior studies; Nandini and Senthilkumar observed substantial reductions in IOP following combined small-incision cataract surgery with trabeculectomy, reporting postoperative control rates ranging from 60% to 90% [15, 16]. The slightly higher IOP control observed in POAG patients in our study mirrors findings by Iancu and Corbu, indicating that anatomical differences in PACG, including a shallower anterior chamber, may limit the extent of IOP reduction [17].

Visual outcomes were markedly improved, with 90% of patients achieving postoperative visual acuity between 6/6 and 6/18 and a mean LogMAR improvement from 0.9325 ± 0.51724 preoperatively to 0.2912 ± 0.43638 postoperatively ($p < 0.001$). This supports observations by Hu et al. and Young et al., who highlighted that combined cataract and glaucoma surgery can facilitate visual rehabilitation while concurrently improving IOP [12, 18]. Our findings also align with IA et al. and Singh et al., who reported significant visual gains following phacotrabeculectomy [19, 20].

Complete surgical success at six months was achieved in 43.8% of PACG and 45.0% of POAG patients, with qualified success in 8.8% and 1.2%, respectively and only one patient experiencing failure (1.2%). These success rates are comparable to the outcomes reported by Khandelwal et al. and Cao et al., emphasizing that combined surgery can achieve effective long-term IOP control [13, 21]. The slightly

lower success in PACG patients may reflect the structural predisposition of narrower angles and increased early postoperative complications, as also suggested by Solano et al. and Yoo et al [22, 23].

Postoperative complications were relatively infrequent, with 72.5% of patients experiencing no complications. Posterior capsular opacity (PCO) occurred in 11.2%, over-filtration in 3.8% and isolated events such as hyphaema, vitreous hemorrhage, cystic bleb and IOL decentration in ≤2.5% of cases. These findings are consistent with prior literature, indicating that combined surgery is generally safe when performed by experienced surgeons [24, 25].

5. Limitations of the Study

This study had a relatively small sample size of 80 patients, which may limit the generalizability of the findings to broader populations. Additionally, the follow-up period was limited to six months and longer-term outcomes regarding IOP control, visual recovery and late postoperative complications were not assessed. Being a single-center study conducted at a tertiary care eye hospital, selection bias cannot be excluded and the results may not fully reflect outcomes in different healthcare settings. Variations in patient anatomy and comorbidities may also influence surgical success, which were not fully controlled in this observational design.

6. Conclusion

Combined trabeculectomy and manual small-incision cataract surgery is an effective and safe procedure for patients with PACG and POAG, providing significant improvement in visual acuity and meaningful reduction in intraocular pressure. The procedure demonstrated a high rate of surgical success with minimal postoperative complications. These findings support the use of combined surgery in resource-constrained settings, allowing simultaneous management of visually significant cataract and glaucoma, improving patient compliance and reducing the need for multiple interventions. Longer-term studies with larger sample sizes are recommended to validate these results.

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Conflicts of Interest

There are no conflicts of interest.

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