Outcomes of combined cataract and trabeculectomy surgery in Kenya: A multicenter retrospective case series study

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Abstract
Background: Globally, cataracts and glaucoma are the leading causes of blindness accounting for 43% and 12% of the total cases respectively. In developing countries, glaucoma is generally diagnosed at an advanced stage, only when the patient seeks advice for cataract surgery. This study aimed to evaluate the outcome of combined trabeculectomy and cataract surgery in terms of intraocular pressure, visual acuity, associated complications, and clinically relevant factors that are associated with a poor outcome.

Methods: Hospital-based, retrospective case series. Patients who underwent combined cataract and glaucoma surgery at Kisii Eye Hospital, Tenwek Mission Hospital and the Kenyatta National Hospital from January 2012 to December 2016 were included. Data was collected using a questionnaire and analysed using SPSS version 23. Descriptive analysis was done to determine the means, frequencies and proportions of the various variables. Chi-square was used to test association; confidence level was taken as 95% ($p < 0.05$) where applicable.

Results: Majority of the patients did not have sustained pressure control, especially for the subgroups of patients with longer follow-ups. Over sixty-two per cent of those who returned for 4 – 8 weeks of follow-up achieved an improvement in visual acuity and nearly 21% achieved 6/18 or better. Acute postoperative complications included corneal edema, flat bleb, and encapsulated bleb among others. Different age groupings were found to be a significant risk factor for poor visual outcomes in patients who underwent combined surgery. There was no statistically significant difference in baseline characteristics and mean IOP between phaco-trab and small incision cataract surgery with trabeculectomy (SICST) surgery groups except for LogMAR visual acuity ($p = 0.015$).

Conclusion: Poor follow-up limited the precision of the findings but also means that a 'one-stop' operation for glaucoma and cataracts may be a viable and practical approach to management.

Keywords: Cataract surgery, trabeculectomy, phacoemulsification, trabeculectomy, intraocular pressure

Introduction

Globally, visual impairment disproportionately affects individuals in low- and middle-income countries, where more than 90% of visually impaired people reside (World Health Organization, 2023). Cataracts and glaucoma are the two leading causes of blindness, accounting for 43% and 12% of cases, respectively (Bastawrous et al., 2019). In Kenya, where economic constraints and limited access to medical services prevail, glaucoma is often diagnosed only when patients seek cataract surgery, making combined cataract and trabeculectomy procedures a practical treatment option (Ling & Bell, 2018). These surgeries aim to address both cataracts and elevated intraocular pressure (IOP) in a single intervention, potentially improving visual outcomes and reducing the need for lifelong anti-glaucoma medication (Cardakli et al., 2020). This study evaluates the outcomes of combined cataract and trabeculectomy surgery in Kenya, focusing on factors such as intraocular pressure control, visual acuity improvement, and complications.

Cataracts and glaucoma are two of the most significant contributors to visual impairment worldwide, with a large burden of disease particularly in low- and middle-income countries (Bastawrous et al., 2019; World Health Organization, 2023). Cataract surgery is the most effective treatment for restoring vision in cataract patients. Still, when coupled with glaucoma, surgical management becomes more complex due to the necessity of addressing both visual recovery and IOP control (Ling & Bell, 2018). Historically, research has focused on isolated treatment of either cataracts or glaucoma. Still, in recent years, the focus has shifted towards evaluating the effectiveness of combined cataract and glaucoma surgeries, such as trabeculectomy, especially in patients with advanced disease or limited healthcare access (Khandelwal et al., 2015; Zhang et al., 2015).

Several studies have examined the outcomes of combined cataract extraction and trabeculectomy procedures, particularly in their effectiveness in controlling IOP and improving visual acuity (Zhang et al., 2015). For instance, a Cochrane review by Zhang et al. (2015) provided a comprehensive evaluation of the risks and benefits of combined surgery versus cataract surgery alone in patients with both conditions. Similarly, Khandelwal et al. (2015) investigated the surgical outcomes of a safe surgery system combining trabeculectomy with cataract extraction, finding that while combined surgeries are effective, they also carry risks such as unplanned return to the operating room (Cardakli et al., 2020). These studies highlight the need for careful consideration of patient-specific factors when opting for combined surgical approaches and the importance of follow-up care. However, despite the growing body of research, there are still significant gaps in understanding the long-term outcomes of these combined surgeries, particularly in low-resource settings such as sub-Saharan Africa, where healthcare infrastructure can limit follow-up care and postoperative management (Bastawrous et al., 2019). Furthermore, much of the existing research has been conducted in high-income countries, where access to healthcare resources, technologies, and postoperative care differs substantially from low- and middle-income regions (Mencucci et al., 2023).

Despite the growing body of research on cataract and glaucoma surgeries, particularly in combined procedures like trabeculectomy and cataract extraction, significant gaps remain in understanding the long-term outcomes of these treatments in low-resource settings. Most existing studies have focused on high-income countries with robust healthcare infrastructures, leaving a gap in knowledge regarding the effectiveness and safety of these procedures in low-income regions, where access to postoperative care and advanced medical technologies is limited (Mencucci et al., 2023; Zhang et al., 2015). Furthermore, while research has demonstrated the success of combined surgeries in managing intraocular pressure and restoring vision, limited attention has been given to understanding patient outcomes over extended periods, especially in environments where follow-up care may be inconsistent (Cardakli et al., 2020).

While significant advancements have been made in understanding the outcomes of combined cataract and trabeculectomy surgeries, particularly in high-income countries, gaps remain in the long-term evaluation of these procedures in low-resource settings like Kenya. Long-term outcomes referred to the sustained results observed in patients over an extended period following surgery, i.e., beyond 6 months. The high prevalence of cataracts and glaucoma, coupled with limited access to healthcare, underscores the importance of studying the effectiveness and safety of combined surgeries in such regions. This study aims to contribute to the body of knowledge by evaluating the long-term outcomes of combined cataract and trabeculectomy surgeries in Kenya, focusing on intraocular pressure control, visual acuity improvement, and postoperative complications. In doing so, it hopes to provide valuable insights for improving patient care and surgical approaches in resource-constrained environments.

Materials and Methods

The study was conducted from January 2012 to December 2016 and involved the review of patient records from three major tertiary eye hospitals in Kenya. A retrospective case series design was chosen to assess the long-term outcomes of these surgeries in real-world clinical settings, focusing

on IOP control, surgical success rates, and complications. By analyzing existing patient data, this approach allowed for a comprehensive evaluation of surgical outcomes over time, making it possible to identify trends, success rates, and areas for improvement in surgical practice. The use of well-defined inclusion and exclusion criteria, along with rigorous data collection and statistical analysis, ensures the reliability and validity of the findings.

Study settings

The study was conducted in three prominent tertiary eye hospitals in Kenya, each known for its specialized ophthalmic care. The Kisii Eye Centre (KEC) is a pioneering institution using a social entrepreneurial model to provide comprehensive eye care and advanced diagnostic and treatment technologies. Tenwek Mission Hospital (TMH), renowned for its busy Eye Unit, offers extensive outpatient and surgical services, including a high volume of cataract and other eye surgeries, and serves as a primary referral centre for the Southwest region of Kenya. Kenyatta National Hospital (KNH), the largest referral and teaching hospital in the region. It provides specialized ophthalmology services and facilities for postgraduate training and research. These settings were selected due to their significant roles in managing cataract and glaucoma cases, ensuring a diverse and representative sample of patients undergoing combined cataract and glaucoma surgeries.

Sampling

The sampling method in this study was based on a case series approach, involving all participants who met the inclusion criteria during the specified study period. Rather than calculating a predetermined minimum sample size, the study included all patients who underwent combined cataract and glaucoma surgery within the designated timeframe. A total of 89 eyes from 74 patients were reviewed.

Recruitment of study participants and data collection

The patient selection process involved reviewing patient records from three tertiary eye hospitals in Kenya: Kisii Eye Centre, Tenwek Mission Hospital, and Kenyatta National Hospital. To identify eligible participants, the researchers generated a list of cases by entering relevant ICD-10 codes version 2019, into the hospital computer systems. The principal investigator then retrieved patient files using these codes, ensuring the records met the inclusion criteria for the study. This method enabled a comprehensive capture of all cases involving combined Small Incision Cataract Surgery (SICS) or Phacoemulsification with Trabeculectomy performed within the specified time frame. Patients with incomplete or lost records, secondary glaucoma, traumatic cataracts, previous glaucoma surgeries, or use of surgical techniques other than SICS or Trabeculectomy were excluded. A pre-designed questionnaire was used to capture demographic details, examination findings, type of surgery, complications, and postoperative outcomes. Patient information was retrieved from both computerized and paper surgical databases, The data was entered into Microsoft Excel and analyzed using SPSS software.

Data analysis

Data analysis was performed using SPSS version 23 to determine frequencies, proportions, and associations within the study data. Descriptive statistics, including means, standard deviations, and medians, were calculated to summarize patient demographics and outcome measures. Pearson correlation coefficients and univariable regression analyses were utilized to explore relationships between outcome measures and demographic or clinical variables. Bivariate analysis, including chi-square tests and odds ratios with 95% confidence intervals, was conducted to identify risk factors for successful or poor outcomes. Multivariable analyses were performed to adjust for confounding variables, with a significance level set at $p < 0.05$.

Ethical considerations

Approval was obtained from the KNH/UON Ethics and Research Committee and the ethics committees of the participating hospitals—Kisii Eye Centre, Tenwek Mission Hospital, and Kenyatta National Hospital. Patient anonymity was maintained through the use of coded questionnaires and secure data handling procedures. Access to the data was restricted to the primary investigator and authorized research assistants, all of whom adhered to strict confidentiality and data protection standards. After analysis, all digital records were deleted to safeguard participant privacy.

Results

Socio-demographic and Ocular Characteristics

Figure 1 is the flow diagram showing how the study participants were selected. Records of 89 eyes of 74 patients were reviewed. Records of 4 eyes (2 patients) were missing. The remaining 85 eyes of 72 patients were distributed as follows: 27 eyes (20 patients) that underwent Phaco-trab surgery and 58 eyes (52 patients) that underwent SICST surgery. KNH had the least number of patients.

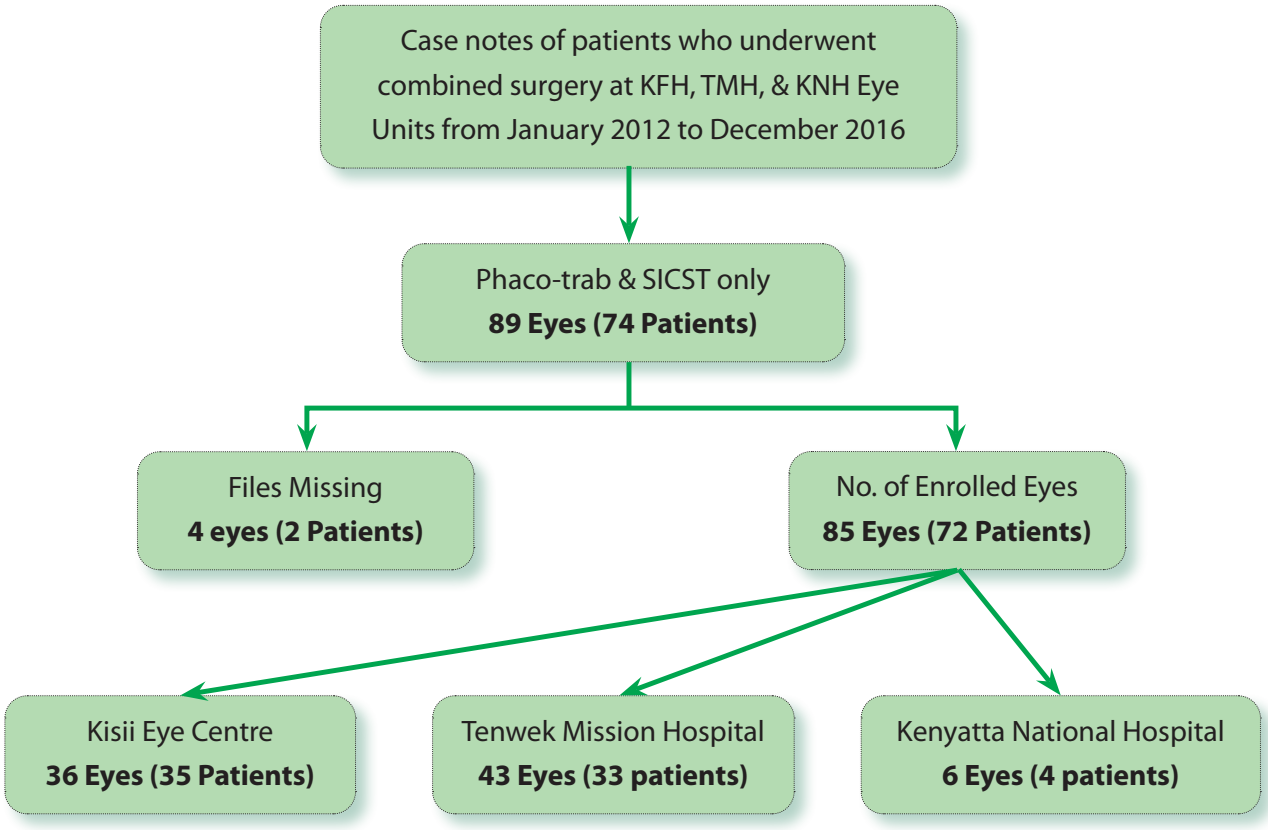

Figure 1: Flow Chart showing data collection of patient's records reviewed at selected health facilities from January 2012 to December 2016

The demographic details of the patients are in *Table 2*. The mean age of the studies patients was 72 years (SD 12.5, range 26–102 years) and 43 (59.7%) were men.

Table 1: Pre-operative demographic characteristics (n=72 patients)

Demographics	**Number of patients (%)**
Age (Years)	
Mean (± Standard Deviation)	71.7 (±12.50)
Range	26 – 102
Sex	
Male	43 (59.7)
Female	29 (40.3)
Laterality	
Unilateral	59 (81.9)
Bilateral	13 (18.1)

Table 2 displays the baseline and ocular characteristics of patients who underwent either phaco-trab or SICST.

There were no statistically significant findings between baseline characteristics of patients undergoing phaco-trab and SICST. The distribution by sex was relatively similar between the two groups, with slightly more females in the phaco-trab group (63.0%) compared to the SICST group (56.9%) but this difference was not statistically significant (p = 0.597). Both groups had almost similar mean ages, with the phaco-trab group averaging 72.8 years and the SICST group 72.0 years (p = 0.777).

Statistically significant differences were observed in visual acuity and pathologies affecting outcomes. Patients in the phaco-trab group had better preoperative visual acuity (mean LogMAR of 1.4) compared to those in the SICST group (mean

LogMAR of 1.7), p = 0.015. Additionally, the SICST group had a higher proportion of patients with additional pathologies (60.3%) affecting surgical outcomes compared to the phaco-trab group (37.0%), p = 0.045. The difference in mean IOP between the groups, (28.9 mmHg for phaco-trab and 28.6 mmHg for SICST) was not statistically (p = 0.910).

Table 2: Baseline and ocular characteristics of patients undergoing phaco-trab and SICST surgery

Characteristics		Surgery type		p Value
	Total number of patients	Phaco-trab (n = 27 eyes)	SICST (n = 58 eyes)	
Sex				
Male	43 ((59.7)	17 (63.0)	33 (56.9)	0.597
Female	29 ((40.3)	10 (37.0)	25 (43.1)	
Age (years)				
Mean age in years (SD)	71.7 (±12.50)	72.8 ±10.77	72.0 ±12.53	0.777
Range	26 – 102	57 (45 – 102)	69 (26 – 95)	
LogMAR visual acuity	1.6 ± 0.63	1.4 ± 0.64	1.7 ± 0.62	0.015
IOP (mmHg)	28.7 ± 11.48	28.9 ± 13.22	28.6 ± 9.96	0.910
Pathologies affecting outcome				
With pathologies	45 (52.9)	10 (37.0)	35 (60.3)	0.045
Without pathologies	40 (47.1)	17 (63.00	23 (39.7)	
Type of cataract*				
Nuclear Sclerosis	38 (48.7)	11 (40.7)	27 (46.6)	0.841
Cortical	37 (47.4)	13 (48.1)	24 (41.4)	
Posterior Subcapsular	3 (3.8)	3 (11.1)	7 (12.1)	

**Files were documented based on the more prominent cataract type.*

Visual Outcome and Change in Intraocular Pressure After Surgery

Figure 2 shows the post operative IOP of the studied eyes. Thirty-four point six of the eyes that underwent phaco-trab had preoperative IOP in the range of 21-30 mmHg and 67.8% of the eyes that underwent SICST had preoperative IOP in the range of 21-40 mmHg. Overall, 82.9% of the eyes had an IOP of 18 mmHg and above.

Figure 2: Preoperative intraocular pressure of the study population (n=85 eyes)

The follow-up period was extended to a maximum of six months. By the end of this period, 21.2% of the patients had dropped out and were no longer participating in the follow-up assessments. The mean postoperative IOP trend from baseline to 24 weeks in *Figure 3* shows different patterns between the two surgical groups. For eyes that underwent phaco-trab, the mean IOP remained consistently below 18 mmHg throughout the 24-week follow-up period, indicating effective IOP control. In contrast, eyes that underwent SICST experienced a gradual increase in mean IOP, exceeding 18 mmHg between 9- and 24 weeks post-surgery.

Although these trends suggest a difference in postoperative IOP control between the two surgical methods, statistical analysis revealed no significant difference in the IOPs between the groups at any time point during the follow-up period.

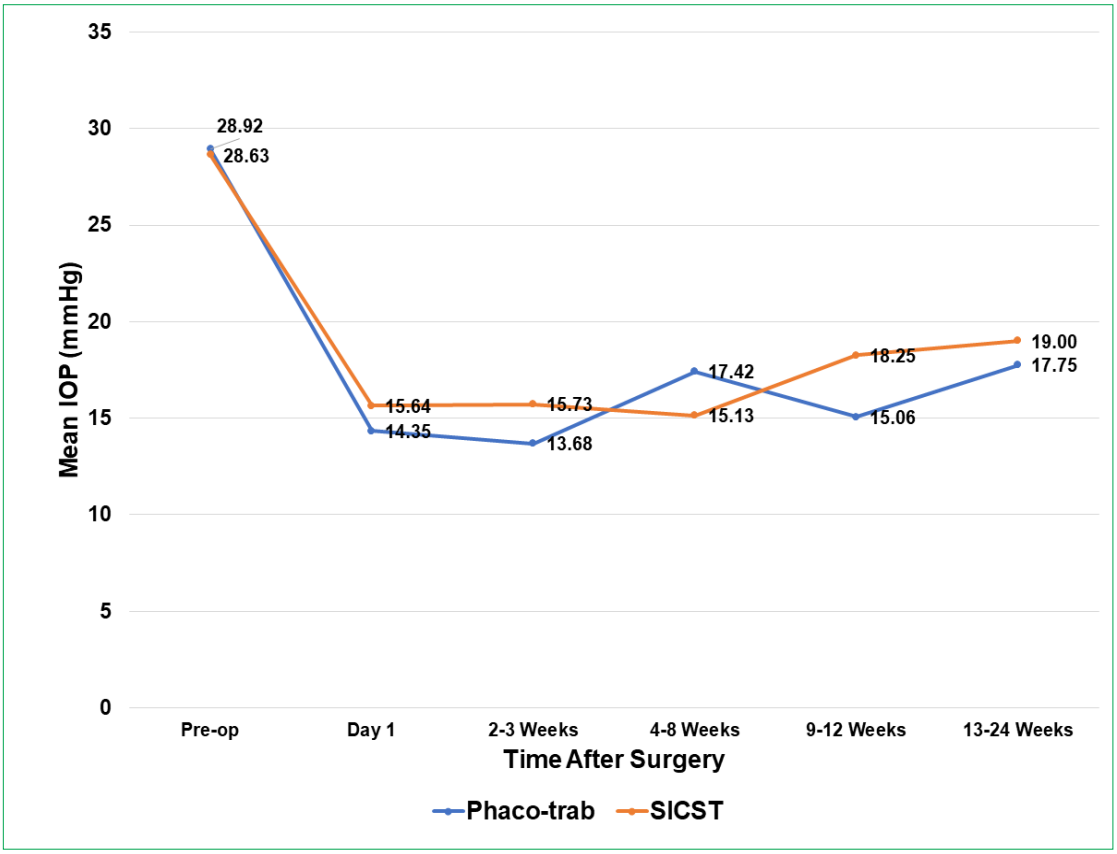

Figure 3: Mean intraocular pressure trend from baseline to 24 weeks

Comparison of the Outcome of Combined Cataract and Trabeculectomy Surgery

Table 3 presents the success rates of Phaco-trab and SICST based on IOP control criteria at more than 3 months postoperatively. Three categories of outcomes were defined: complete success, qualified success, and failure.

Complete success (IOP <18 mmHg without medication) was achieved in 2 out of 8 eyes (25.0%) in the Phaco-trab group and 1 out of 9 eyes (11.1%) in the SICST group, with an overall success rate of 17.6% for both surgeries combined. This difference between the groups was not statistically significant ($p = 0.765$).

Qualified success (IOP <18 mmHg with the use of medication) was observed in 3 eyes (37.5%) in the Phaco-trab group and 4 eyes (44.4%) in the SICST group, making the combined qualified success rate 41.2%. Similarly, this outcome did not show a statistically significant difference ($p = 0.497$).

Failure (IOP >18 mmHg at the end of follow-up) occurred in 3 eyes (37.5%) in the Phaco-trab group and 4 eyes (44.4%) in the SICST group, with a combined failure rate of 41.2%. Again, there was no significant difference between the two groups ($p = 0.497$).

Table 3: Success trend of Phaco-trab & SICST surgeries according to different IOP criteria at > 3 months

IOP Success Rate	Surgery type		Overall Outcome	P Value
	Phaco-trab (n = 8 eyes)	SICST (n = 9 eyes)		
Complete success*	2 (25.0)	1 (11.1)	3 (17.6%)	0.765
Qualified success#	3 (37.5)	4 (44.4)	7 (41.2%)	0.497
Failure+	3 (37.5)	4 (44.4)	7 (41.2%	0.497

**Complete Success = IOP <18 mmHg at the end of follow-up*
#Qualified Success = IOP <18 mmHg with medication at the end of follow-up
+Failure = IOP >18 mmHg at the end of follow-up

Figure 4 shows the trend in mean LogMAR VA from baseline to 24 weeks highlighting significant differences in visual outcomes between the phaco-trab and SICST groups. The analysis shows that both groups experienced improvements in VA after surgery, but the rate and magnitude of improvement differed. The SICST group consistently demonstrated worse visual outcomes across all follow-up periods.

At baseline (pre-op), the phaco-trab group exhibited better visual acuity compared to the SICST group, and this difference was statistically significant (p = 0.015). Immediately following surgery, on Day 1, both groups showed improvements in VA, but the SICST group still had worse visual acuity, with a p-value of 0.023. The trend continued at 2–3 weeks, where visual acuity improved in both groups, but the difference remained significant (p = 0.050). The phaco-trab group consistently had better VA during this early postoperative period.

By the 4–8-week follow-up, both groups demonstrated further improvement in VA, with the phaco-trab group continuing to show better results than the SICST group. The significant difference between the two groups remained (p = 0.011), indicating that patients in the SICST group struggled with worse vision throughout the follow-up period. Despite improvements in VA for both groups, the SICST group did not achieve the same level of visual recovery as the phaco-trab group.

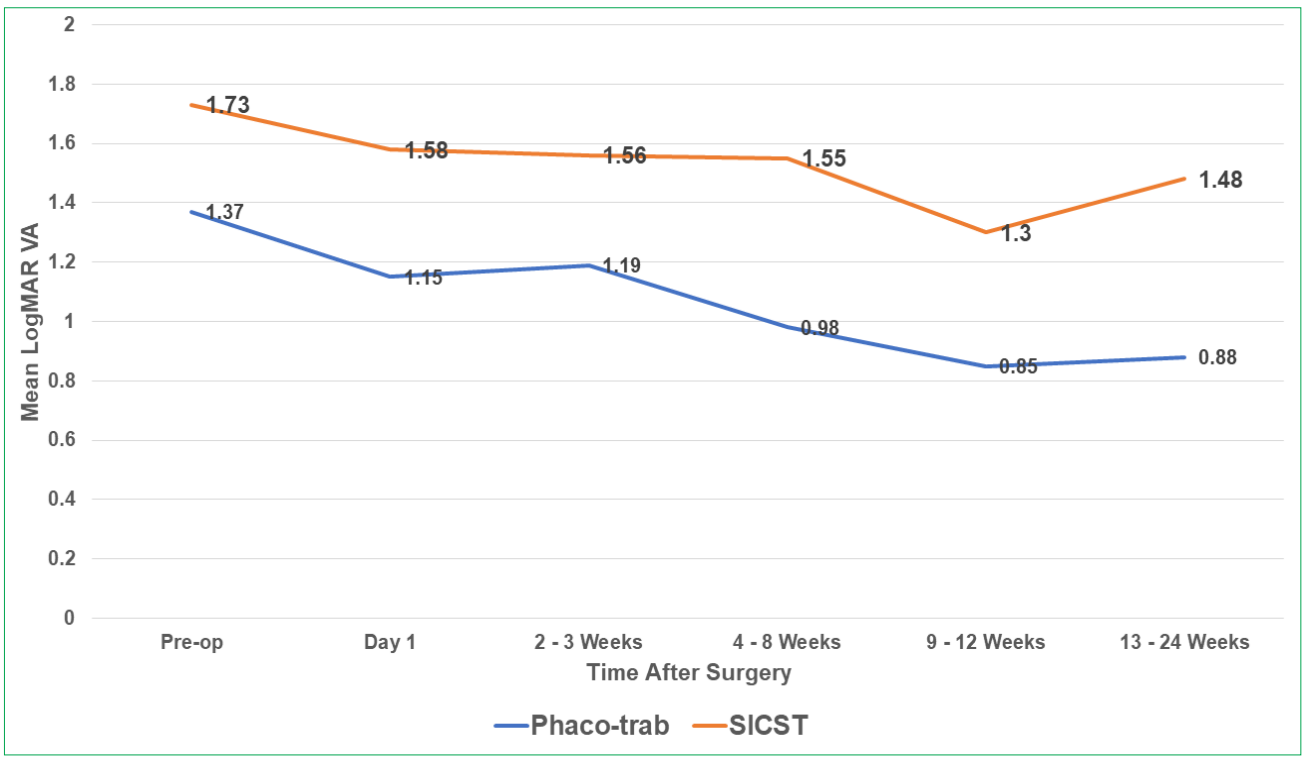

Figure 4: Mean LogMAR visual acuity trend from baseline to 24 weeks

At the final follow-up (4–8 weeks postoperatively), the best visual acuity recorded for patients was used to assess overall outcomes. Among the study population, 11 eyes (20.8%) achieved a LogMAR VA of 0.50 (equivalent to 6/18 or better on the Snellen chart), indicating that a substantial portion of patients had relatively good postoperative vision. Additionally, 13 eyes (24.5%) achieved a LogMAR VA of 1.00 (equivalent to 6/60 or better), reflecting moderate visual improvement. These outcomes indicate that, although both phaco-trab and SICST surgeries led to improvements in visual acuity, the phaco-trab group generally achieved better long-term visual outcomes compared to the SICST group.

There was a decrease in the number of patients taking anti-glaucoma drugs in the different types (14 phaco-trab and 18 SICST) in the preoperative period to 2 in each different types at 24 weeks follow-up visits.

Complications Associated with Combined Cataract and Trabeculectomy Surgery

Intraoperative complications were exclusively observed in patients who underwent SICST, with no complications reported in the phaco-trab group. The most common complications in the SICST group included posterior capsule (PC) tears and vitreous loss, each affecting 5 eyes. Additionally, 3 eyes had flat anterior chamber (3 eyes) and 2 eyes had zonular dialysis.

Table 4 shows that most postoperative complications occurred in SICS, especially within the first 30 days.

Table 4: Postoperative complications

Complications	Phaco-trab		SICST		Overall outcome	
	<30 Days	≥30 Days	<30 Days	≥30 Days	<30 Days	≥30 Days
Uveitis	1	0	2	4	3	4
Flat Bleb	2	0	5	1	7	1
Vitreous Hemorrhage (VH)	0	0	1	0	1	0
Hyphema	0	0	2	0	2	0
Edema	0	0	3	0	3	0
Corneal Ulcer	1	0	1	0	2	0
Cystic Bleb	0	0	2	0	2	0
Dislocated Intraocular Lens	0	0	2	0	2	0
Over drainage	0	0	2	0	2	0
Posterior Capsular Opacification (PCO)	0	1	1	6	1	7
Endophthalmitis	0	0	1	0	1	0
Hypotony	0	0	1	0	1	0
Flat Anterior Chamber (AC)	0	0	2	0	2	0
Corneal Scar	0	1	0	1	0	2
Total	**4**	**2**	**25**	**12**	**29**	**14**

Postoperative complications played a significant role in the visual outcomes of patients undergoing phaco-trab and SICST. *Table 5* highlights the distribution of these complications across the two surgical groups. The majority of patients in both groups had no complications, with 77.8% of phaco-trab patients and 56.9% of SICST patients reporting no adverse postoperative effects. However, corneal edema, which occurred in 11.1% of phaco-trab and 17.2% of SICST patients, was a relatively common complication and a significant contributor to poor visual outcomes.

Table 5: Causes of poor vision outcome after surgery

Complications	Type of surgery		
	Phaco-trab (n=27)	SICST (n=58)	All (n = 85)
None	21 (77.8%)	33 (56.9%)	54 (63.5%)
Corneal Edema	3 (11.1%)	10 (17.2%)	13 (15.3%)
Corneal Decompensation	0 (0.0%)	1 (1.7%)	1 (1.2%)
Hyphaema	0 (0.0%)	4 (6.9%)	4 (4.7%)
Uveitis	1 (3.7%)	5 (8.6%)	6 (7.1%)
PCO	1 (3.7%)	4 (6.9%)	5 (5.9%)
Endophthalmitis	1 (3.7%)	1 (1.7%)	2 (2.4%)

Table 6 shows that patients aged 81 and above were more likely to have poor postoperative visual outcomes than the younger patients (aged ≤ 60 years), with a p-value of 0.050 and an odds ratio (OR) of 0.231 (95% CI 0.05-0.99). The differences between the intermediate age groups (61-70 years and 71-80 years) were not statistically significant.

The type of surgery also factor influenced visual outcomes. Patients who had phaco-trab surgery were less likely to have poor visual outcomes compared to those undergoing SICST surgery, with a p-value of 0.014 and an OR of 0.227 (95% CI 0.07-0.74).

Table 6: Association between poor visual outcome and various patient-related factors and procedure-related factors

Factors	Poor visual outcome				
	Number of patients	%	OR	95%CI	p-value
Age grouping					
≤60	12	14.1	REF		
61-70	21	24.7	0.63	(0.16-2.47)	0.506
71-80	33	38.8	0.56	(0.19-1.69)	0.302
≥81	19	22.4	0.23	(0.05-0.99)	0.050
Sex					
Male	50	58.8	REF		
Female	35	41.2	0.56	(0.19-1.69)	0.302
Type of cataract					
Nuclear Sclerotic	38	44.7	REF		
Cortical	37	43.5	1.20	(0.40-3.75)	0.745
Posterior Subcapsular	10	11.8	1.12	(0.23-5.58)	0.890
Type of surgery					
Phaco-trab	27	31.8	REF		
SICST	58	68.2	0.23	(0.07-0.74)	0.014

Other parameters, such as sex and the type of cataract (nuclear sclerotic, cortical, or posterior subcapsular), were not found to be significant predictors of poor visual outcomes.

Discussions

Visual Outcome and Change in Intraocular Pressure After Surgery

Preoperative IOP levels varied significantly between the two surgical groups. For phaco-trab, 34.6% of eyes had an IOP in the range of 21-30 mmHg, while 67.8% of eyes undergoing SICST had IOPs between 21-40 mmHg. This indicates that

SICST was predominantly performed on eyes with higher preoperative IOPs, reflecting its use in more advanced glaucoma cases. Previous studies such as those by Zhang, et al. (2015) had similarly noted that SICST is often selected for patients with more severe glaucomatous conditions due to its capacity to address higher IOP levels. The mean IOP trends over the 24-week follow-up period highlight significant differences between the two procedures. Phaco-trab showed consistently effective IOP control, with mean IOP remaining below 18 mmHg throughout the follow-up. This result aligns with findings from Zhao et al. (2023), who reported sustained IOP control with phaco-trab, emphasizing its effectiveness in long-term management. On the other hand, SICST demonstrated a gradual increase in mean IOP, surpassing 18 mmHg between 9- and 24 weeks post-surgery. This increase suggests that while SICST may provide initial IOP reduction, its long-term control may be less stable. Jiang et al. (2018) observed similar trends, where SICST showed variable IOP control over extended follow-ups. Despite these trends, statistical analysis revealed no significant difference in IOP between the two groups at any follow-up time point. This lack of statistical significance contrasts with some studies like those by De Bernardo et al. (2023), which found significant differences in IOP control between different surgical techniques. The absence of significant differences in our study may be attributed to the variability in individual patient responses and the diverse nature of glaucoma severity across the study population.

Visual outcomes in our study were encouraging, with 62.4% of patients showing an improvement in visual acuity and nearly 21% achieving 6/18 or better. This is consistent with the results from Weinreb et al. (2014), who reported similar improvements in visual acuity following combined surgeries. The visual acuity improvement in both surgical groups reflect the overall success of these procedures in enhancing visual outcomes, despite the differences in IOP control. The fact that visual acuity initially worsened in the phaco-trab group compared to baseline but improved over time contrasts with findings from Zawadzka & Konopińska (2024), who noted that phaco alone can lead to significant improvements in visual acuity. This discrepancy may be attributed to the combined nature of the phaco-trab procedure, where the dual intervention might initially affect visual acuity before long-term benefits become apparent.

Our study's findings align with and diverge from existing literature in several ways. For instance, the consistent IOP control observed with phaco-trab corroborates with Bastawrous et al. (2019) and Zhang et al. (2015), reinforcing its efficacy for sustained IOP management. In contrast, the variable IOP control with SICST observed in our study resonates with the variability reported by Cardakli et al. (2020). suggesting that while SICST can be effective, it may require additional interventions for optimal long-term IOP management. The overall improvement in visual outcomes supports the conclusions of previous studies highlighting the benefits of combined cataract and glaucoma surgeries. However, the higher rate of postoperative complications such as corneal edema and flat blebs reported in our study, particularly in the SICST group, underscores the need for careful monitoring and management of these complications, as noted by Dietze et al. (2024) and Sun et al. (2017).

Comparison of the Outcome of Combined Cataract and Trabeculectomy Surgery

The analysis of postoperative IOP outcomes categorized into complete success, qualified success, and failure highlights the efficacy of the two surgical techniques. Complete success, defined as achieving IOP <18 mmHg without medication, was observed in 25.0% of the phaco-trab group and 11.1% of the SICST group, resulting in a combined success rate of 17.6%. The lower percentage of complete success in SICST compared to phaco-trab suggests that while both surgeries aim to lower IOP, phaco-trab might be slightly more effective in achieving target pressures without the need for additional medications. However, the lack of statistical significance ($p = 0.765$) implies that the difference may not be clinically meaningful and could be influenced by the small sample sizes. A qualified success, where IOP <18 mmHg is maintained with medication, was observed in 37.5% of the phaco-trab group and 44.4% of the SICST group, leading to a combined qualified success rate of 41.2%. This indicates that both surgeries are relatively effective in managing IOP when medication is used, but the statistical insignificance ($p = 0.497$) suggests that the additional need for medication does not differ substantially between the two techniques. The failure rates, defined as IOP >18 mmHg at the end of follow-up, were similar between groups (37.5% for phaco-trab and 44.4% for SICST), further supporting the conclusion that both surgeries have comparable long-term IOP control, though variability exists.

These findings resonate with studies like those by Soatiana et al. (2013) and Ling & Bell (2018), which found that while combined procedures are generally effective in lowering IOP, the degree of success can be influenced by the specific surgical technique and patient characteristics. The lack of significant difference in failure rates between the two groups aligns with the variability observed in other studies, where success rates for combined surgeries are often comparable.

Visual acuity trends reveal a clearer distinction between the two surgical methods. At baseline, the phaco-trab group demonstrated better visual acuity compared to the

SICST group, with this difference persisting throughout the follow-up period. This difference was statistically significant at various points, including immediately post-surgery (Day 1) and at 2–3 weeks and 4–8 weeks follow-up. The SICST group consistently exhibited poorer visual acuity compared to the phaco-trab group, with significant differences noted at every follow-up interval. The trend in visual acuity improvement observed in our study is consistent with findings from several other studies. For instance, Jiang et al. (2018) also reported that combined procedures like phaco-trab generally yield better visual outcomes compared to other techniques, largely due to the less invasive nature and better visual recovery profile of the phaco-trab method. The persistent difference in visual acuity between phaco-trab and SICST might be attributed to the more complex nature of SICST, which can involve additional intraoperative and postoperative factors affecting visual recovery.

The decrease in anti-glaucoma medication uses from preoperative to 24 weeks postoperative is an encouraging outcome, reflecting the effectiveness of both surgical approaches in reducing the need for medications. Despite the decrease, the number of patients on medications was similar between the two groups at 24 weeks, indicating comparable overall management of glaucoma post-surgery. This observation is consistent with studies like those by Khandelwal et al. (2015) and De Bernardo et al. (2023), which found that both phaco-trab and SICST effectively reduce the need for medication, though the rate and extent of reduction can vary.

Complications Associated with Combined Cataract and Trabeculectomy Surgery

Intraoperative complications were exclusively observed in the SICST group, with no such events reported in the phaco-trab group. The SICST group experienced posterior chamber (PC) tears and vitreous loss, each affecting 5 eyes. These complications are significant as they can adversely impact visual outcomes and may require additional surgical interventions. Flat anterior chamber and zonular dialysis, occurring in 3 and 2 eyes respectively, also underscore the technical challenges and risks associated with SICST. The absence of intraoperative complications in the phaco-trab group contrasts sharply with the issues encountered in SICST. This difference highlights the relative complexity and potential risks associated with SICST. Previous studies, such as those by Weinreb et al. (2014) and Soatiana et al. (2013), have similarly found that SICST can be associated with a higher incidence of intraoperative complications compared to other combined procedures. The findings from this study align with these observations, emphasizing the need for meticulous surgical technique and patient selection to minimize risks.

Postoperative complications, particularly within the first 30 days, were notably more frequent in the SICST group. *Table 4* illustrates that the majority of complications in SICST occurred within this initial period, including flat bleb and corneal edema. The presence of corneal edema and flat bleb significantly contributes to visual disturbances and patient discomfort, which can hinder the recovery process. Corneal edema, which was observed in 11.1% of the phaco-trab group and 17.2% of the SICST group, was a common postoperative complication. This finding aligns with the literature, where corneal edema is frequently reported as a complication following combined cataract and trabeculectomy surgeries. Studies such as those by Zhang et al. (2015) and Sun et al. (2017) also highlight the prevalence of corneal edema in SICST, attributing it to factors like increased surgical trauma and prolonged inflammation.

Interestingly, the phaco-trab group exhibited fewer postoperative complications overall compared to the SICST group, with 77.8% of phaco-trab patients reporting no adverse effects versus 56.9% in the SICST group. This suggests that phaco-trab may be associated with a more favorable postoperative profile, contributing to better visual outcomes and a smoother recovery. The lower incidence of severe complications such as endophthalmitis and corneal decompensation in the phaco-trab group further supports this observation.

Complications played a significant role in the visual outcomes observed in the study. The phaco-trab group showed a higher proportion of patients with no complications (77.8%) compared to the SICST group (56.9%). This difference is crucial, as complications like corneal edema and hyphema directly impact visual acuity and overall patient satisfaction. The higher rate of corneal edema and other complications in the SICST group may partially explain the less favorable visual outcomes observed in this cohort. This finding is consistent with studies by Khandelwal et al. (2015) and Stark et al. (2006), which report that postoperative complications, particularly in SICST, can lead to prolonged recovery times and suboptimal visual outcomes. These studies underscore the importance of optimizing surgical techniques and postoperative care to mitigate complications and enhance patient outcomes.

Complications Associated with Combined Cataract and Trabeculectomy Surgery

Age emerged as a significant predictor of poor visual outcomes, particularly for patients aged 81 and above. This finding aligns with existing literature that highlights the correlation between advanced age and increased risk

of poor surgical outcomes. Older patients are generally more prone to visual complications due to a combination of factors, including reduced ocular healing capacity, the presence of coexisting ocular or systemic conditions, and a higher likelihood of having more advanced cataracts or pre-existing retinal conditions. The odds ratio (OR) of 0.231 for patients aged 81 and above indicates a notable risk of poor outcomes in this demographic. Previous studies, such as those by World Health Organization (2023) and Bastawrous et al. (2019), have similarly reported that elderly patients experience higher rates of postoperative complications and suboptimal visual outcomes compared to younger patients. These studies attribute the increased risk to age-related changes in ocular anatomy and function, as well as the potential for other age-related health issues that can affect recovery and visual results. However, the lack of significant differences in outcomes between intermediate age groups (61-70 years and 71-80 years) suggests that the risk of poor visual outcomes becomes more pronounced only in the very elderly, consistent with findings from Mencucci et al. (2023), who observed that the impact of age on surgical outcomes intensifies with age.

The type of surgery was identified as a significant factor influencing visual outcomes. Patients undergoing phaco-trab surgery had a lower likelihood of poor visual outcomes compared to those undergoing SICST, with an OR of 0.227. This indicates that phaco-trab surgery may offer better postoperative visual outcomes, likely due to differences in surgical techniques, case complexity, and potentially fewer intraoperative and postoperative complications. A study by Weinreb et al. (2014) has reported similar findings, noting that phaco-trab surgery often results in better visual outcomes compared to SICST, attributed to the less invasive nature of the phacoemulsification process and improved intraoperative and postoperative management. Phaco-trab's lower complication rates and more predictable results can be linked to its ability to effectively address both cataracts and elevated intraocular pressure with fewer adverse effects on vision. The findings from this study underscore the importance of selecting an appropriate surgical technique based on the patient's specific needs and potential risks.

Contrary to some expectations, sex and the type of cataract (nuclear sclerotic, cortical, or posterior subcapsular) did not emerge as significant predictors of poor visual outcomes in this study. The lack of association between sex and visual outcomes is consistent with findings from studies such as those by Jiang et al. (2018) and Zhao et al. (2023), which found no significant differences in visual recovery based on gender. Similarly, the type of cataract did not significantly affect visual outcomes in this cohort. This finding aligns with studies like those by Cardakli et al. (2020) and Ling et al. (2018), which suggest that while different cataract types may present varying surgical challenges, they do not necessarily lead to different postoperative visual outcomes. The uniformity in outcomes across different cataract types in this study could be due to the standardized approach in surgical management and postoperative care.

Conclusions

The conclusions made from the findings of this study were that:

1. Elderly patients are more likely to have poor postoperative visual outcomes after combined cataract and glaucoma surgery than the younger patients
2. Poor follow-up limited the precision of the findings
3. A 'one-stop' operation for glaucoma and cataracts may be a viable and practical approach to management
4. Visual outcomes were generally better in the phaco-trab group, with a significant proportion of patients achieving improved visual acuity compared to the SICST group.

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