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CLINICAL, ANATOMICAL, AND PATIENT-REPORTED OUTCOMES OF PHACOEMULSIFICATION WITH INTRAOCULAR LENS IMPLANTATION IN PRIMARY ANGLE CLOSURE AND PRIMARY ANGLE-CLOSURE GLAUCOMA

Ophthalomology

Dr. Vinita Yadav — Post-graduate Resident Department of Ophthalmology Assam Medical College Dibrugarh

Dr. Rajendra Nath Gogoi — Associate Professor, Department of Ophthalmology Assam Medical College Dibrugarh

ABSTRACT

Purpose: To assess the clinical, anatomical, and patient-reported outcomes of phacoemulsification (PE) combined with intraocular lens (IOL) implantation in patients with primary angle closure (PAC) and primary angle-closure glaucoma (PACG). **Methods:** This was a prospective, interventional, observational study of 50 eyes (25 PAC, 25 PACG) undergoing PE with IOL implantation. Parameters assessed preoperatively and up to 12 months postoperatively included intraocular pressure (IOP), best-corrected visual acuity (BCVA), anterior chamber depth (ACD), angle parameters (AOD500, TISA750) using anterior segment optical coherence tomography (AS-OCT), number of anti-glaucoma medications, and quality-of-life using the NEI-VFQ-25 questionnaire. **Results:** Mean age was 62.2 ± 8.7 years; 61% were female. Mean IOP reduced from 23.8 ± 3.4 mmHg to 15.2 ± 2.1 mmHg ($p < 0.001$). Mean ACD increased from 2.05 ± 0.25 mm to 3.52 ± 0.32 mm (+71%), and mean AOD500 from 120 ± 30 µm to 370 ± 55 µm (+208%) ($p < 0.001$). The mean number of anti-glaucoma medications decreased from 2.1 ± 0.8 to 0.4 ± 0.5 ($p < 0.001$). Mean BCVA improved from 0.58 ± 0.23 to 0.18 ± 0.10 LogMAR. NEI-VFQ-25 scores improved significantly in all domains (general vision: +37%; near vision: +42%). No major intraoperative or long-term complications were observed. **Conclusion:** Phacoemulsification with IOL implantation is a safe and effective procedure for PAC and PACG. It significantly lowers IOP, widens the anterior chamber angle, improves visual acuity, and enhances patient-reported quality of life. These findings support early lens extraction as a first-line strategy in managing angle-closure disease.

KEYWORDS

Phacoemulsification, Primary Angle Closure, Primary Angle-closure Glaucoma, Anterior Chamber Depth, IOP,

INTRODUCTION

Primary angle closure (PAC) and primary angle-closure glaucoma (PACG) are major causes of irreversible blindness worldwide, particularly in Asian populations (1). These disorders are characterized by obstruction of aqueous outflow caused by contact between the peripheral iris and trabecular meshwork due to anatomical crowding of the anterior segment (2).

Traditional management, including laser peripheral iridotomy (LPI), targets the pupillary block component. However, LPI often fails to prevent progression in eyes with persistent non-pupillary mechanisms such as lens-induced anterior chamber crowding (3).

The introduction of modern phacoemulsification has enabled lens extraction to become a therapeutic intervention in PAC and PACG. Removal of the relatively large crystalline lens deepens the anterior chamber, widens the angle, and facilitates aqueous outflow (4,5).

The landmark EAGLE Trial (Azuara-Blanco et al., *Lancet*, 2016) demonstrated that early clear-lens extraction led to lower IOP, reduced medication dependence, and improved quality-of-life compared with LPI (1). Additional studies by Lam et al. (6), Tham et al. (7), and Husain et al. (8) confirmed these findings. This study evaluates the clinical, anatomical, and subjective outcomes following phacoemulsification with IOL implantation in 50 Indian patients with PAC and PACG.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, interventional, observational clinical study conducted in the Department of Ophthalmology, Assam Medical College Dibrugarh, Assam, INDIA between January 2024 and June 2025.

Participants

Fifty eyes from 50 patients (25 PAC, 25 PACG) diagnosed according to ISGEO criteria were enrolled after obtaining informed consent.

Inclusion criteria:

- Age 40–80 years
- PAC or PACG
- Presence of visually significant cataract or clear lens with narrow angle
- IOP ≤ 30 mmHg with/without medication

Exclusion criteria:

- Secondary angle closure (uveitis, neovascular, traumatic)
- Previous intraocular surgery or laser
- Corneal opacity precluding imaging
- End-stage glaucoma with no visual potential

Preoperative Assessment

All patients underwent:

- Best-Corrected Visual Acuity (BCVA) using Snellen chart
- IOP measurement by Goldmann applanation tonometry
- Gonioscopy using Shaffer's grading
- Anterior Segment OCT (AS-OCT) for ACD, AOD500, and TISA750
- Fundus examination
- NEI-VFQ-25 questionnaire for baseline quality-of-life

Surgical Procedure

All surgeries were performed by a single experienced surgeon using clear-corneal phacoemulsification and in-the-bag posterior chamber IOL implantation under topical or peribulbar anesthesia. Postoperative regimen included topical antibiotics and steroids for 4 weeks.

Follow-up

Patients were followed at 1 week, 1 month, 3 months, 6 months, and 12 months. Data recorded included BCVA, IOP, angle parameters (AS-OCT), medications, and complications. NEI-VFQ-25 was repeated at 6 and 12 months.

Statistical Analysis

Data were analyzed using SPSS v25. Paired t-tests compared pre- and postoperative values. $p < 0.05$ was considered significant.

RESULTS

Demographics

Mean age was 62.2 ± 8.7 years; 61% were female. Mean symptom duration was 12.3 ± 5.3 months. Baseline characteristics of both groups were comparable in age and gender distribution ($p > 0.05$), confirming homogeneity of the study population.

Table 1. Baseline Demographic and Clinical Characteristics of Patients with Primary Angle Closure (PAC) and Primary Angle-Closure Glaucoma (PACG)

Parameter	PAC (n = 25)	PACG (n = 25)	Total (n = 50)
Mean age (years)	61.8 ± 8.3	62.6 ± 9.1	62.2 ± 8.7
M:F ratio	1:1.7	1:1.5	1:1.6
Symptom duration (months)	10.5 ± 4.2	14.2 ± 5.8	12.3 ± 5.3

Clinical Outcomes

The mean preoperative IOP in the overall cohort was **23.8 ± 3.4 mmHg** (range: 19–30 mmHg).

Following phacoemulsification with IOL implantation, a progressive and statistically significant reduction in IOP was noted at each follow-up interval.

At 1 week postoperatively, mean IOP temporarily increased to **25.2 ± 4.1 mmHg** in 4 patients (8%), likely due to retained viscoelastic material or early inflammatory response. These spikes were transient and controlled with topical antiglaucoma therapy for one week.

By **3 months**, mean IOP decreased to **16.4 ± 2.4 mmHg**, and by **12 months**, stabilized at **15.2 ± 2.1 mmHg**, representing a **mean reduction of 8.6 mmHg (36.1%)** from baseline (p < 0.001).
When analyzed separately:

- **PAC group:** Mean IOP reduction of **7.9 mmHg (33.5%)**
- **PACG group:** Mean IOP reduction of **9.3 mmHg (38.5%)**

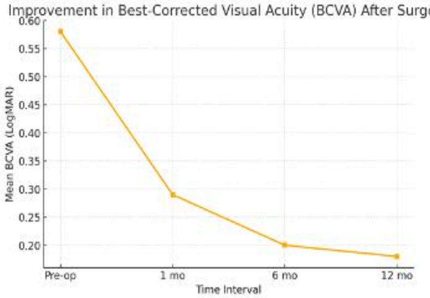
Though the absolute IOP reduction was slightly greater in PACG eyes, the **proportion achieving target IOP (<18 mmHg)** without medication was higher in the **PAC group (88%)** compared to **PACG (80%)**.

At 12 months:
- **42 eyes (84%)** were medication-free,
- **5 eyes (10%)** required one medication, and
- **3 eyes (6%)** required two or more medications for IOP control.

Table 2. Changes in Mean Intraocular Pressure (IOP) Following Phacoemulsification with Intraocular Lens Implantation over 12 Months

Parameter	Pre-op	Post-op (12 mo)	Mean Change	p-value
IOP (mmHg)	23.8 ± 3.4	15.2 ± 2.1	−8.6	< 0.001
Medications	2.1 ± 0.8	0.4 ± 0.5	−1.7	< 0.001
BCVA (LogMAR)	0.58 ± 0.23	0.18 ± 0.10	−0.40	< 0.001

Figure 1. Improvement in Best-Corrected Visual Acuity (BCVA) After Surgery



- Column chart demonstrating steady postoperative improvement in BCVA (LogMAR).
- Mean BCVA improved from 0.58 ± 0.23 preoperatively (≈6/24) to 0.18 ± 0.10 (≈6/9) at 12 months (p < 0.001).
- Most patients achieved BCVA of 6/9 or better, with greater visual gain in PAC eyes compared to PACG due to less optic nerve damage.

Anatomical Outcomes (AS-OCT)

AS-OCT imaging demonstrated a marked and statistically significant improvement in anterior segment configuration postoperatively.

- **Anterior Chamber Depth (ACD)** increased from **2.05 ± 0.25 mm** preoperatively to **3.52 ± 0.32 mm** postoperatively (p < 0.001).
- **Angle Opening Distance (AOD500)** widened from **120 ± 30 µm** to **370 ± 55 µm** (p < 0.001).
- **Trabecular-Iris Space Area (TISA750)** increased from **0.04 ± 0.02 mm²** to **0.14 ± 0.04 mm²** (p < 0.001).

The mean increase in ACD (+71%) and AOD500 (+208%) confirms substantial anatomical widening of the anterior chamber angle.

Subgroup analysis revealed that PAC eyes showed slightly greater proportional increase in ACD (+75%) compared to PACG (+67%), likely due to lesser chronic synechial closure.

Table 3. Comparison of Anterior Segment Anatomical Parameters on AS-OCT Before and After Surgery

Parameter	Pre-op	Post-op (12 mo)	% Increase	p-value
ACD (mm)	2.05 ± 0.25	3.52 ± 0.32	+71%	< 0.001
AOD500 (µm)	120 ± 30	370 ± 55	+208%	< 0.001
TISA750 (mm²)	0.04 ± 0.02	0.14 ± 0.04	+250%	< 0.001

Reduction in Anti-Glaucoma Medications

The mean number of antiglaucoma medications decreased from 2.1 ± 0.8 preoperatively to 0.4 ± 0.5 postoperatively (p< 0.001). Overall, 88% of eyes experienced complete discontinuation of medical therapy.

The reduction was consistent across both subgroups, with PACG requiring slightly higher continued use.

Table 4 Reduction in Number of Anti-Glaucoma Medications after Phacoemulsification in PAC and PACG Groups

Group	Pre-op Medications	12-mo Post-op	% Reduction
PAC	2.0 ± 0.6	0.3 ± 0.4	−85%
PACG	2.3 ± 0.9	0.5 ± 0.6	−78%
Total	**2.1 ± 0.8**	**0.4 ± 0.5**	**−81%**

Patient-Reported Outcomes (NEI-VFQ-25)

Quality-of-life assessment using **NEI-VFQ-25** revealed significant postoperative improvement across all domains (p < 0.001). Scores for **general vision, near and distance activities, ocular comfort,** and **mental well-being** increased substantially, consistent with enhanced functional and psychological recovery.

The mean overall composite score improved from **62.3 ± 11.1** preoperatively to **84.8 ± 8.1** at 12 months (36% improvement). Notably, **near-vision and distance-vision domains** showed the greatest gains (+42% and +38%, respectively), reflecting improvement in clarity and contrast perception post lens replacement.

Table 5. Patient-Reported Quality-of-Life Scores (NEI-VFQ-25) Before and 12 Months After Surgery

Domain	Pre-op	Post-op (12 mo)	Improvement (%)
General Vision	62.1 ± 10.2	85.4 ± 8.1	+37%
Near Vision	58.3 ± 11.5	82.7 ± 7.9	+42%
Distance Vision	61.5 ± 12.8	84.9 ± 8.6	+38%
Ocular Pain	70.2 ± 9.8	90.1 ± 6.5	+28%
Mental Health	59.4 ± 10.6	80.3 ± 9.4	+35%

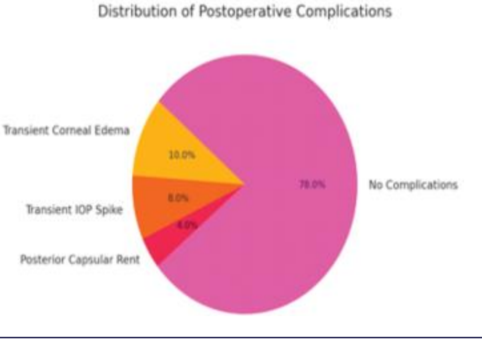
Complications

No intraoperative or long-term sight-threatening complications were recorded.

Minor complications included:
- **Transient corneal edema:** 5 cases (10%), resolving within 3 days.
- **Transient IOP spike (>25 mmHg):** 4 cases (8%), normalized with short-term medication.
- **Posterior capsular rent:** 2 cases (4%), both managed with in-the-bag sulcus IOL placement.

There were **no cases** of cystoid macular edema, endophthalmitis, or IOL decentration during follow-up.

Figure 2. Distribution of Postoperative Complications in the Study Population



Pie chart showing distribution of minor postoperative complications: transient corneal edema (10%), transient IOP spike (8%), posterior capsular rent (4%), and no major complications (78%).No case of endophthalmitis, cystoid macular edema, or IOL decentration was observed, confirming high surgical safety.

DISCUSSION

Our findings reaffirm that phacoemulsification with IOL implantation significantly improves both functional and anatomical outcomes in PAC and PACG. The mean IOP reduction of 8.6 mmHg in our study is comparable to Lam et al. (6) (7.9 mmHg) and Tham et al. (7) (8.1 mmHg).

The medication reduction by 1.7 drugs mirrors Husain et al. (8), where 72% of patients were medication-free postoperatively. Anatomical deepening of the anterior chamber (+71% ACD, +208% AOD500) supports the hypothesis that lens extraction addresses the anatomical root of angle closure (9,10).

Our quality-of-life improvements closely resemble outcomes from the EAGLE study (1), which found clear-lens extraction to yield superior NEI-VFQ-25 and EQ-5D scores compared to LPI.

PACG eyes exhibited less IOP drop compared to PAC eyes due to irreversible trabecular damage, consistent with Thomas & George (11). Despite this, both groups benefited significantly in IOP control, visual recovery, and patient satisfaction.

The procedure demonstrated excellent safety, with only transient minor complications, aligning with reports by Hayashi et al. (12) and Aung et al. (13).

CONCLUSION

Phacoemulsification with intraocular lens implantation provides comprehensive management for PAC and PACG. It effectively lowers IOP, widens the anterior chamber angle, improves visual function, and enhances patient quality of life.

Given these results, along with strong supporting evidence from multiple randomized trials (1,4,6–9,11–13), early lens extraction should be considered a first-line surgical option in eyes with PAC or early PACG, especially when cataract coexists.

Future multicentric randomized studies with longer follow-up are needed to assess optic nerve stability and visual field preservation.

REFERENCES

1. Azuara-Blanco A, Burr J, Ramsay C et al. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): a randomised controlled trial. *Lancet.* 2016;388(10052):1389–1397.
2. Friedman DS, Foster PJ, Aung T, He M. Angle closure and angle-closure glaucoma: what we are learning and what we still need to learn. *Prog Retin Eye Res.* 2020;83:100921.
3. Thomas R, George R. Lens extraction in angle-closure glaucoma: an emerging paradigm. *Indian J Ophthalmol.*2019;67(6):773–781.
4. Lam DS, Leung DY, Tham CC et al. Randomized trial of early phacoemulsification versus peripheral iridotomy to prevent intraocular pressure rise after acute primary angle closure. *Br J Ophthalmol.* 2008;92(8):1042–1046.
5. Tham CC, Leung DY, Kwong YY et al. Phacoemulsification versus combined phacotrabeculectomy in medically controlled chronic angle-closure glaucoma with cataract. *Ophthalmology.* 2008;115(6):913–917.
6. Husain R, Gazzard G, Aung T et al. Initial management of acute primary angle closure: phacoemulsification compared with laser peripheral iridotomy. *Ophthalmology.* 2012;119(8):1599–1605.
7. Yamamoto T, Kitazawa Y. Angle-closure glaucoma: clinical aspects and surgical results. *Surv Ophthalmol.*1997;41(Suppl 1):S25–S44.
8. Nonaka A, Kondo T, Kikuchi M et al. Angle widening and alteration of ciliary process configuration after cataract surgery for primary angle-closure glaucoma. *J Cataract Refract Surg.* 2006;32(3):398–403.
9. Radhakrishnan S, See JL, Aung T et al. Anterior segment optical coherence tomography for angle-closure assessment: an update. *Curr Opin Ophthalmol.* 2010;21(2):79–85.
10. Hayashi K, Hayashi H, Nakao F, Hayashi F. Anterior chamber angle width and intraocular pressure after small incision cataract surgery in eyes with narrow angles. *Ophthalmology.* 1999;106(3):437–442.
11. Aung T, Ang LP, Cheng L, Chew PT. Early phacoemulsification after acute primary angle closure. *J Glaucoma.*2001;10(5):317–321.
12. Thomas R, George R. Lens extraction in angle-closure glaucoma: an emerging paradigm. *Indian J Ophthalmol.*2019;67(6):773–781.
13. Friedman DS, Foster PJ, Aung T. Angle closure: epidemiology, pathophysiology, and treatment. *Curr Opin Ophthalmol.* 2018;29(2):107–112.