Egyptian Journal of Clinical Ophthalmology "*EJCO*"
An International peer-reviewed journal published bi-annually
Volume 6, Issue 1, June 2023: pp: 65-73 www. ejco.sohag-univ.edu.eg

Original Article

EVALUATION OF ANTERIOR SEGMENT PENTACAM CHANGES BEFORE AND AFTER PHACOEMULSIFICATION VERSUS COMBINED PHACOTRABECULECTOMY IN PRIMARY ANGLE-CLOSURE GLAUCOMA

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Received: 6/4/2023
Accepted: 9/5/2023 **Doi:** 10.21608/ejco.2023.305206

Abstract

Background: *Both Phaco alone and Phaco-trab resulted in changes of the drainage angle, anatomy of the anterior chamber and reduction of intraocular pressure (IOP). The present study aimed to evaluate anterior segment Pentacam changes before and after phacoemulsification versus combined Phacotrabeculectomy in primary angle-closure glaucoma. Methods: This comparative, prospective, randomized controlled interventional study was conducted on 40 cases with primary angle closure glaucoma associated with cataract grade II or more, visual field loss compatible with cataract density admitted and underwent surgery. The study eyes were divided randomly into two groups; group (A) included cases that underwent standard phacoemulsification only while group (B) included cases that underwent combined phacoemulsification and trabeculectomy and both groups underwent pre and post-operative pentacam.* ***Results:*** *There were non-discernible differences between both groups regarding baseline UCVA, BCVA, K1, K2, K max over time, astigmatism, apex pachymetry, thinnest part corneal volume and anterior chamber depth or the follow-up at 1 week, 1 month, 3 months and 6 months. There was discernible difference between both groups regarding baseline anterior chamber angle and chamber volume follow-up at 1 month, 3 months and 6 months. No discernible difference was found regarding safety and efficacy between both groups.* ***Conclusions:*** *It's possible that both methods are similarly effective in curing PACG.There are non-significant pentacam changes between both procedures among cornea(k1,k2,k max, apex pachymetry, thinnest part), among anterior chamber (Ac depth, Ac angle, Chamber volume)*

Keywords: *Phacotrabeculectomy, Angle-closure Glaucoma, Pentacam, anterior segment.*

1. Introduction

Angle closure glaucoma represent one of leading causes of irreversible visual loss due to optic atrophy caused by too high intra ocular pressure (IOP) [1,2]. Cataract removal, in its current version, has been practiced for several decades, and it is a safe and effective surgery. The IOP is lowered after lens removal, which is the only known modifiable risk factor for glaucoma [3]. The incidence of postoperative anatomical changes and complications may be higher especially in combined procedure [4]. Choosing between cataract surgery alone and mixed glaucoma and cataract

surgery can be challenging. This calls for a comparison of the efficacy of Phaco and Phaco-trab [4,5]. Except for eyes with plateau iris configurations, which the Pentacam cannot detect, it has the ability to be used for safe, noncontact screening of glaucomatous eyes [6,7]. The anterior segment structures crucial to the pathogenesis of glaucoma, as well as the approach and success of various techniques of intervention, can be evaluated qualitatively and quantitatively using Pentacam [8]. The present study aimed to evaluate anterior segment Pentacam changes before and after phacoemulsification versus combined Phacotrabeculectomy in primary angle-closure glaucoma.

2. Patients and Methods

This comparative, prospective, randomized controlled interventional study was conducted on 40 cases with primary angle closure glaucoma associated with cataract grade II or more, visual field loss compatible with cataract density admitted and underwent surgery at Sohag University Hospital, Ophthalmology Department, Jan. 2021–Dec. 2022. The Institutional Review Board (IRB) at the Faculty of Medicine approved this research, and it was recorded in the Pan African Clinical Trial Registry (PACTR202108689834812). Exclusion criteria included cases with previous glaucoma and cataract surgery; cases with associated ocular or intraocular inflammations, cases with associated corneal pathology, cases with associated intraocular pathology, cases that lost follow up. Cases with advanced glaucoma (mean deviation score>12 on visual field score using 30-2Humphery visual field analysis). The study eyes were divided randomly into two groups; group (A) included cases who underwent standard phacoemulsification only while group (B) included cases who underwent combined phacoemulsification and trabeculectomy and both groups underwent pre and post-operative pentacam. All participants in the research had a full ophthalmic evaluation, including pre- and post-op visual acuity tests, subjective measurement of refraction, and slit-lamp and fundus examinations, IOP measurements, keratometry and intraocular lens (IOL) measurement, ocular ultrasonography. The main study outcome measures were as follows: logarithm of the minimal angle of resolution for uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) (logMAR); Efficacy and safety of each groups and Pentacam keratometric data including K1, K2, Km and keratometric astigmatism; Pentacam corneal thickness data including Apex Pachymetry, Thinnest location, Corneal volume; Pentacam anterior chamber data including anterior chamber depth, anterior chamber angle Chamber volume.

2.1. *Surgical Steps*

Group (A): Cases underwent standard phacoemulsification as follows; Micro-vitreoretinal knife 20 Gauge was used to make two paracentesis cuts, fig. (1), and then a Clear Cut HP2 Dual Bevel Slit knife was used to make a clear corneal incision Through the paracentesis incision, air was pumped into the anterior chamber (AC), and then trypan blue ophthalmic solution 0.6mg/ml was injected into the AC to stain the anterior capsule, fig. (2). After that, we used an intravenous infusion of a compound sodium lactate solution (Ringer's lactate, I.V.infusion) to flush out any lingering color in AC. Then, we injected a thick cohesive ophthalmic viscoelastic device (OVD) into the AC to maintain the AC during the capsulorrhexis. This OVD was 1.4% sodium hyaluronate ophthalmic solution. When we first started working on capsulorhexis, we cut an angular tab into the anterior capsule. To create a perfectly circular opening, the capsulorhexis forceps were used to grip the tearing edge

and draw the tab in a curvilinear manner, fig. (1). Hydrodissection was performed by injection of Ringer's lactate solution within the cortex, fig. (1). Hydrodelineation was performed by injection of Ringer's lactate solution within the nucleus to facilitate separation of the endonucleus from the epinuclear shells. We performed the stop and chop technique for phacoemulsification in all study eyes, fig. (1). After that, the cortex matter was aspirated and irrigated. Before inserting the Hydrophilic aspheric monovision foldable single-piece intraocular lens, methyl cellulose was injected into the capsular bag and AC of all subject eyes, fig. (1). The wounds were closed up using a hydrating solution of Ringer's lactate. Finally, we applied eye patches after administering eye drops containing an antibiotic and steroid. Group (B): Cases underwent combined phacoemulsification and trabeculectomy as follow; After locally anaesthetizing the eyes as in group A, a fornix based conjunctival flap was done by using surgical scissor and non-toothed, fig. (2), utility forceps after inflating subconjunctival space by 0.1 diluted methylazirinopyroloindledione anti neoplastic antibiotic, then dissection of sub conjunctival tenon to freeing sub conjunctival space over sclera till exposed corneo scleral limbus. A Limbal based scleral flap was done scleral tunnel sharp edged rounded tip knife about half to two thirds of scleral thickness, flap was dissected anteriorly till clear cornea, fig. (3). The two incision for the paracentesis was made, Main incision also, then staining of anterior capsule done and capsulorehxis performed as Group A, fig. (6). Steps of phacoemulsification were done as Group A. Next, a vannus scissors incision was made connecting the two radial incisions, and a block of tissue was removed from the corneo scleral junction using a sharp blade. The blade was started in the clear cornea at the most anterior point attached to the scleral flap. To ensure that the sclerectomy would go smoothly, a peripheral iridectomy was performed. Two interrupted Nylon 10-0 sutures were used to close the scleral flap and regulate the passage of fluid. After that, the conjunctival flap's borders were brought together and stitched using Nylon 10-0 sutures to guarantee there was no leakage. Finally, we applied eye patches after instilling eye drops containing prednisolone acetate 1% and moxifloxacin hydrochloride 0.5%.

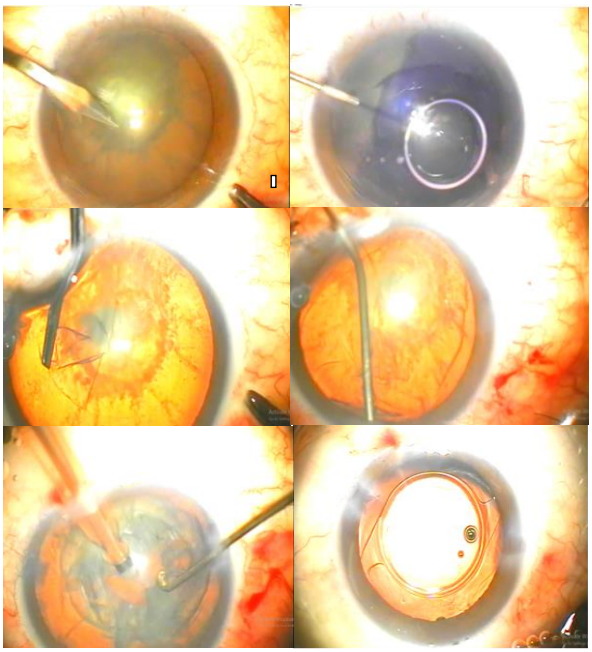


Figure 1: Steps of standard phacoemulsification

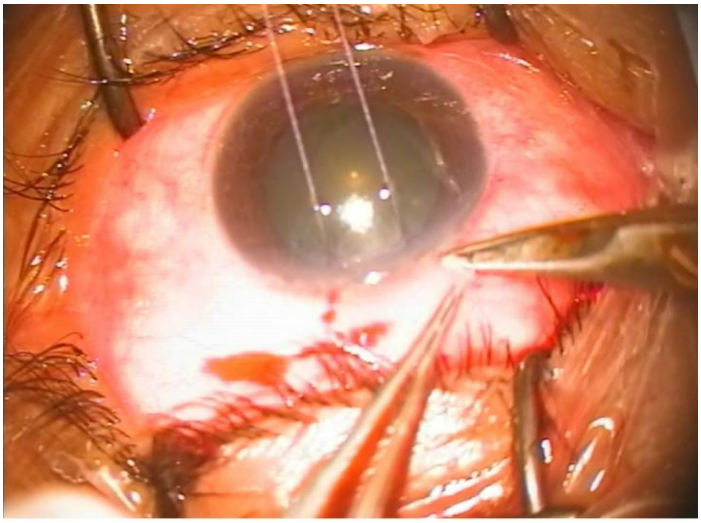


Figure 2: Shows Fornix based conjunctival flap

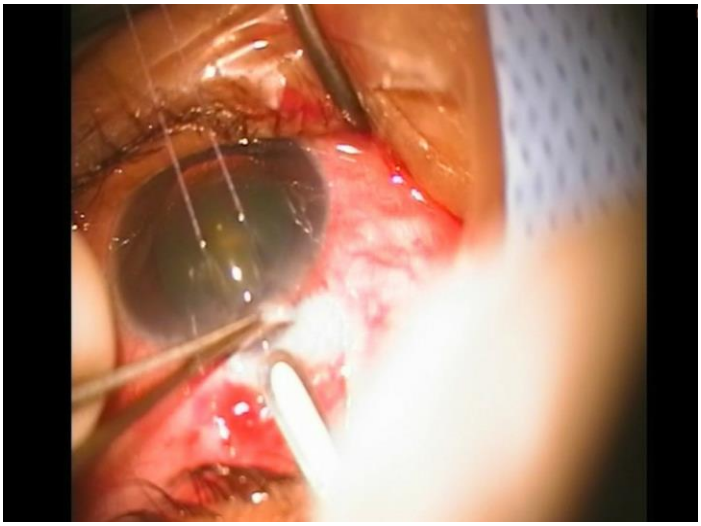


Figure 3: Shows scleral flap by crescent knife

2.1.1. Follow up of refraction as follows:

Follow up done for un corrected visual acuity (UCVA), Best corrected visual acuity (BCVA), Subjective Refraction at 1st Week, 1st month, 3rd month and 6th month post-operative

2.2.1. Follow up Pentacam was done as follows:

1) Keratometry and refraction (K1, K2, Km and astigmatism). Follow up of flattest axis (K1), steepest axis (K2), K Max and corneal astigmatism by Pentacam at, 1st month, 3rd month and 6th month post-operative.

2) Cornea (corneal apex pachymetry, thinnest part and corneal volume). Follow up of corneal apex pachymetry, thinnest part at cornea and corneal Volume by Pentacam at 1st month, 3rd month and 6th month post-operative.

3) Anterior chamber (anterior chamber angle and anterior chamber volume). Follow up of anterior chamber angle and anterior chamber depth by Pentacam at, 1st month, 3rd month and 6th month post-operative.

4) C-Efficacy: uncorrected visual acuity at 6 month postoperative and best corrected visual acuity preoperative.

5) D-Safety: best corrected visual acuity at 6 month and best corrected visual acuity preoperative

2.2. *Statistical analysis*

The data was examined with STATA 17 for Windows. Mean, standard deviation, median, and range were used to illustrate quantitative information. The student t-test was used to evaluate the means of two groups

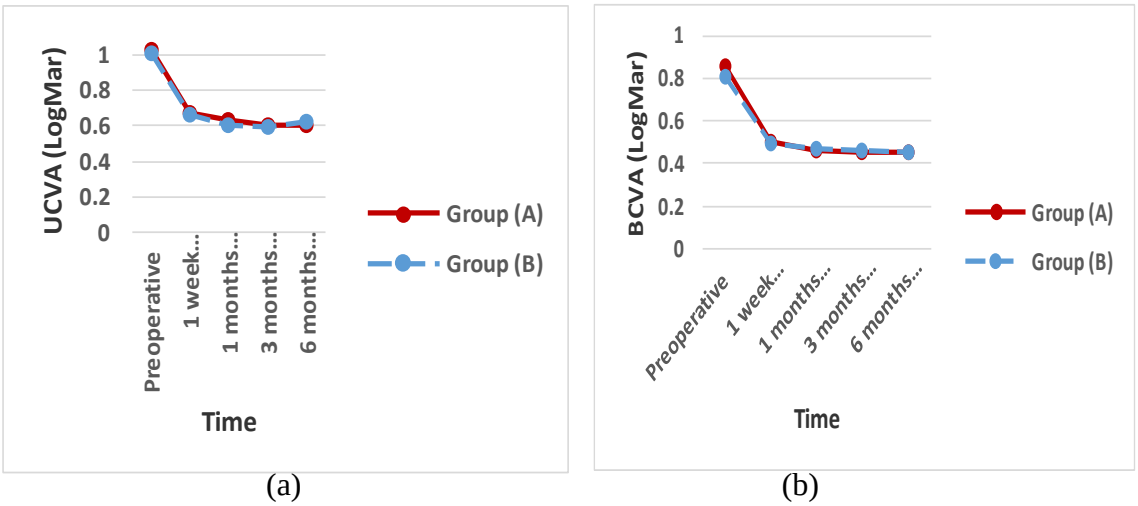
3. Results

Table (1) shows that there were non-discernible differences between both groups regarding age or sex (p= 0.110 and 0.736 respectively). There were non-discernible differences between both groups regarding baseline UCVA and BCVA, or the follow-up at 1 week, 1 month, 3 and 6 months, fig. (4). There were non-discernible differrences between both groups regarding efficacy or safety, tab. (2)**.** There were non-discernible differences between both groups regarding baseline K1, K2, K max over time and astigmatism or the follow-up at 1 week, 1 month, 3 months and 6 months, fig. (5)**.** There were no discernible differences between both groups regarding baseline apex pachymetry, thinnest part and corneal volume and follow up at 1 week, 1 month, 3 months and 6 months, fig. (6)**.** There were non-discernible differences between both groups regarding baseline anterior chamber depth or the follow-up at 1 week, 1 month, 3 and 6 months. There was discernible difference between both groups regarding baseline anterior chamber angle, non-discernible differences between both groups at 1 week, 1 month, 3 months and 6 months. There were discernible differences between both groups regarding chamber volume follow-up at 1 month, 3 months and 6 months, non-discernible differences between both groups regarding baseline Chamber volume and 1-week follow-up, fig. (7)**.** There were no complications during surgery documented in our research; however, a summary of the postoperative complications is provided in tab. (3). Complicated cases are excluded, but the subsequent management and fate of these complications are summarized in tab. (3).

Table 1: Demographic characteristics of the studied groups:

		Phaco group (n= 20)	Phacotrab group (n= 20)	95% CI	P
Age		60.15 ± 2.739	61.75 ± 3.401	-3.58, 0.38	0.110
Gender	▪ ***Male***	7 (35.0%)	6 (30.0%)	-	0.736
	▪ ***Female***	13 (65.0%)	14 (70.0%)		

Data is expressed as mean and standard deviation or as percentage and frequency.



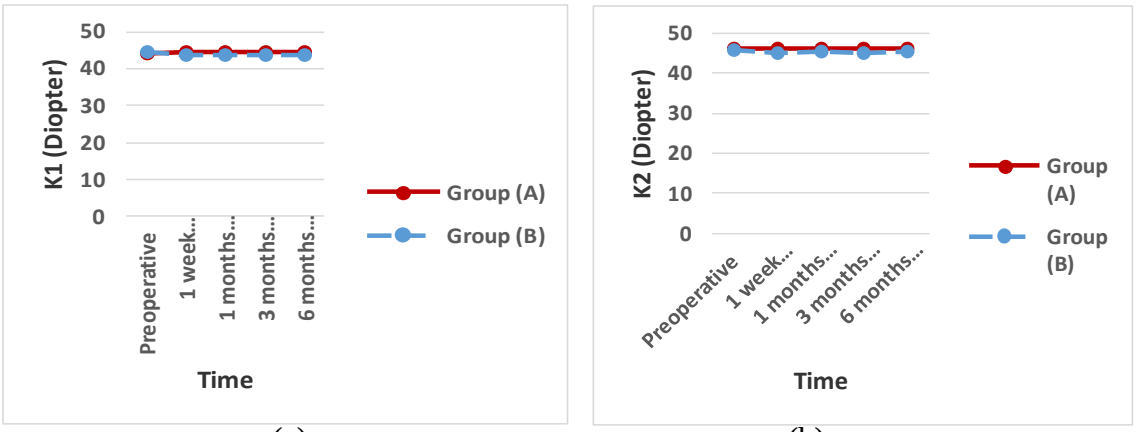
(a) (b)

Figure 4: Comparison between both groups regarding baseline UCVA (a) and BCVA (b) and follow up at 1 week, 1 month, 3 months and 6 months.

Table 2: Comparison of Efficacy and Safety of the studied procedures:

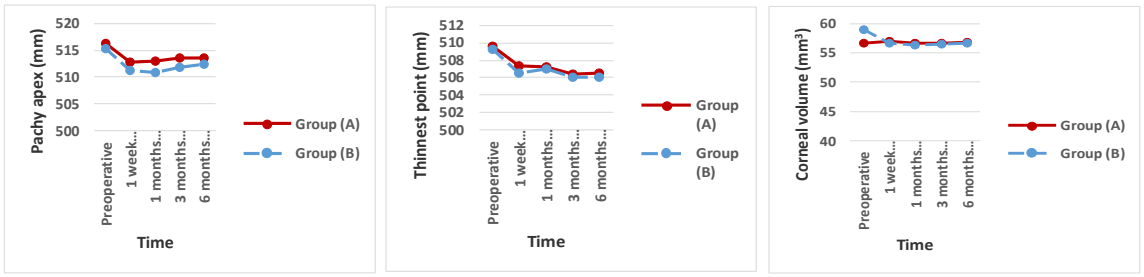
	Phaco group (n= 20)	Phacotrab group (n= 20)	95% CI	P
Efficacy UCVA6m/BCVApre)	0.78 ± 0.355	0.80 ± 0.250	- 0.21, 0.18	0.878
Safety (BCVA6m/BCVApre)	0.53 ± 0.209	0.50 ± 0.176	-0.10, 0.15	0.641

Data is expressed as mean and standard deviation.



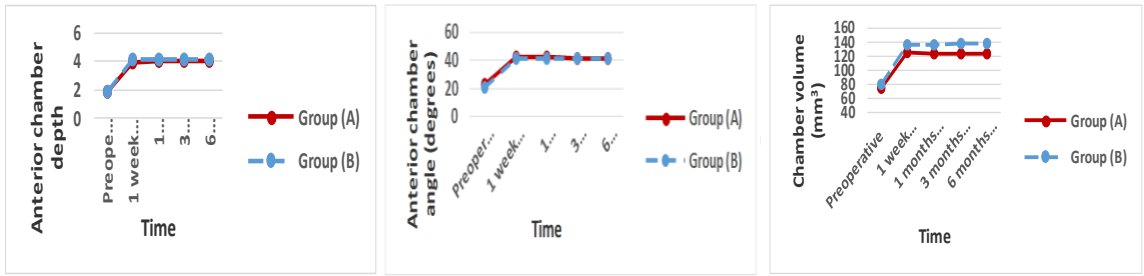
(a) (b)

Figure 5: Comparison between both groups regarding baseline K1 (a), K2 (b), K max over time (c) and astigmatism (d) and follow up at 1 week, 1 month, 3 months and 6 months.



(a) (b) (c)

Figure 6: Comparison between both groups regarding baseline Apex Pachymetry (a), thinnest part (b) and corneal volume (c) and follow up at 1 week, 1 month, 3 months and 6 months.



(a) (b) (c)

Figure 7: Comparison between both groups regarding baseline anterior chamber depth (a), anterior chamber angle (b) and chamber volume (c) and follow up at 1 week, 1 month, 3 months and 6 months.

Table 3: Postoperative complications in the two study groups

Complications	Group A N=20	Group B N=20	Management	Fate
PCO	1	1	- Peripheral faint PCO that didn't affect vision - UDVA and CDVA remained stable in both cases at 0.2 and 0 logMAR till the end of the study	Follow-up
PPME	1	1	- Conservative management -1% prednisolone acetate eye drops, a therapeutic steroid One drop of Nevanac (Alcon Laboratories, Inc.) three times a day; Ibuprofen (Motrin, Advil, etc.) - pharmaceuticals, Illinios, USA). -Take two 250mg tablets of acetazolamide twice	- In both groups, PPME improved over time - One of them showed sub foveal cystoid macular oedema So prepared and underwent to subsequent intravitreal injection

4. Discussion

There were non-discernible differences between both groups regarding baseline BCVA or the follow-up at 1 week, 1 month, 3 months, 6 months. In similarity with our study, Hansapinyo et al [9] compared long-term clinical outcomes of phacoemulsification versus phacotrabeculectomy in PACG eyes with cataract and reported that there were non-discernible differences between both groups regarding mean Log MAR BCVA during the follow-up period. Also, El Sayed et al [10] found that there was no discernible difference in BCVA between both groups preoperatively or at the final follow-up. Regarding efficacy and safety, there were non-discernible differences between both groups regarding efficacy or safety. In agreement with the results, a study by Rhiu et al [11] found There was no statistically discernible variation in best-corrected visual acuity between the preoperative and postoperative. Regarding mean baseline and follow up values of K1, K2 and Km there were non-discernible differences between both groups regarding baseline or the follow-up at 1 week, 1 month, 3 months and 6 months. Regarding mean baseline and follow up values of anterior chamber depth (ACD), there were non-discernible differences between both groups regarding baseline ACD or the follow-up at 1 week, 1 month, 3 months, 6 months. There was a discernible statistical difference between follow up results and the respective baseline value, the mean ACD was approximately doubled in 1st week postoperative in phacoemulsification group and phacotrabeculectomy group, without further discernible changes along the postoperative follow up. Similar results were found by Mokbel et al [12] there was discernible increase in ACD values at 3rd month compared with baseline values for both groups. The maximum deepening of ACD was noticed in group phacotrab group with 94.27% increase (136). Regarding mean baseline and follow up values of Anterior chamber angle, no statistically discernible difference was observed between both groups. Similar results were found by Mokbel et al [12] in his study there was discernible increase in the anterior chamber angle (ACA) values in all studied groups compared to preoperative values. The highest percent of increase in ACA was recorded in phacotrabeculectomy group (128.40%). Regarding mean baseline and follow up values of Chamber volume (ACV), there were discernible differences between both groups regarding ACV follow-up at 1 month, 3 months and 6 months (p= 0.033, 0.026 and 0.028 respectively), non-discernible differences between both groups regarding baseline ACV and 1-week follow-up. In agreement with our results, Chelerkar et al [13] Before and after 12 months, we saw a broadening of the angle in the phacoemulsification and Phacotrab groups. Chi-square analysis revealed that there was a statistically noticeable post-operative angle broadening in both groups. At 12 months, there was no statistically discernible distinction between the two groups in terms of angle broadening. Similarly, Ün and Cömerter, 2022 measured Prior to surgery, the average ACA measured with the Pentacam device was 21.07 ± 4.16°. (. Average pretreatment ACD was 1.79 ± 0.24 mm (1.39-2.22) and ACV was 72.55 ± 20.64 mm3. Third-month post-op topographic observations included a mean angle of 35.76 ± 7.32° (range: 20.1-46.9), a mean ACD of 3.52 ± 0.95 mm (1.15-4.46), and a mean ACV of 133.21 ± 25.21 mm3 (range: 81-173) (p< 0.01). (133). Using the Pentacam method, Zhao et al. [14] studied the morphological changes of the anterior segment in cases with PACG following phacoemulsification. Discernible increases in ACV, CACD, PACD, ACA inferiorly, ACA nasally ACA temporally and ACA superiorly were observed. A similar pattern was observed in the CACG group. The main limitations of our study could be summarized in 4

main points. The relatively small sample size and the short-term follow-up period (6 follow-up months) were our 2 major limitations Fixation of the site of the keratome incision in all cases regardless the steep meridian axis that added to the significance of the postoperative statistical differences represent third limitations that affect keratometric readings and astigmatism. Furthermore, our use of the hydrophilic type of IOL for intraocular implantation and our inability to provide the hydrophobic type of IOL to guard against the development of postoperative PCO, due to cost-related issues was the fourth study limitations. Therefore, we recommend further additional future multicenter studies with larger sample sizes and long-term follow-up durations to investigate and evaluate effect different surgical techniques of ACG on refraction, cornea, and anterior chamber.

5. Conclusions

It's possible that both methods are similarly effective in curing PACG. There are non-significant pentacam changes between both procedures among cornea (k1,k2,k max, apex pachymetry, thinnest part) ,among anterior chamber (Ac depth, Ac angle, Chamber volume)

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