

# Two cases of persistent shallow anterior chamber after cataract surgery combined with goniosynechialysis

Kang-Yi Yang<sup>1,2,3,4</sup>, Zhi-Qiao Liang<sup>1,2,3,4</sup>, Xuan-Zhu Chen<sup>1,2,3,4</sup>, Hui-Juan Wu<sup>1,2,3,4</sup>

<sup>1</sup>Department of Ophthalmology, Peking University People's Hospital, Beijing 100044, China

<sup>2</sup>Eye Diseases and Optometry Institute, Beijing 100044, China

<sup>3</sup>Beijing Key Laboratory of Diagnosis and Therapy of Retinal and Choroid Diseases, Beijing 100044, China

<sup>4</sup>College of Optometry, Peking University Health Science Center, Beijing 100044, China

**Correspondence to:** Hui-Juan Wu. Department of Ophthalmology, Peking University People's Hospital, No.11 Xizhimen South Street, Xicheng District, Beijing 100044, China. dr\_wuhuijuan@126.com

Received: 2022-05-28 Accepted: 2022-12-05

**DOI:10.18240/ijo.2023.02.21**

**Citation:** Yang KY, Liang ZQ, Chen XZ, Wu HJ. Two cases of persistent shallow anterior chamber after cataract surgery combined with goniosynechialysis. *Int J Ophthalmol* 2023;16(2):312-315

**Dear Editor,**

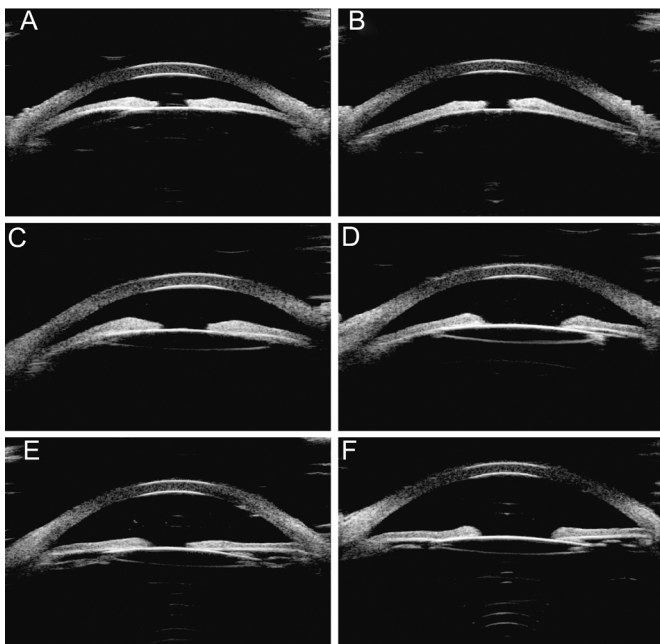
Two cases of primary angle-closure glaucoma (PACG) with persistent shallow anterior chamber after phacoemulsification, intraocular lens (IOL) implantation and goniosynechialysis (GSL) were presented.

PACG, which mainly presents with mechanical obstruction of the trabecular meshwork, is clinically characterized by elevated intraocular pressure (IOP) secondary to the apposition of peripheral iris or a synechial closure of the angle<sup>[1]</sup>. A previous study reported that angle-closure glaucoma eyes experienced widening and deepening of anterior chamber angles following cataract extraction and IOL implantation, which could probably normalize the IOP<sup>[2]</sup>. A randomized controlled trial demonstrated that in comparison with laser peripheral iridotomy (LPI), clear-lens extraction showed greater advantages in efficacy and cost-effectiveness and could be proposed as the first-line initial treatment for PACG<sup>[3]</sup>. Combining GSL with lens extraction results in a wider anterior chamber angle and a lower IOP than cataract extraction only<sup>[4]</sup>. However, in the real clinical practice, not all patients who received cataract surgery undergo postoperative deepening of the anterior chamber and widening of anterior chamber angle.

Herein, we present two cases of PACG patients with persistent shallow anterior chamber after phacoemulsification, IOL implantation and GSL.

The case reports followed the tenets of the Declaration of Helsinki and were approved by the Ethics Committee of Peking University People's Hospital (approval number: 2022PHB256-001). Written informed consent was obtained from every patient.

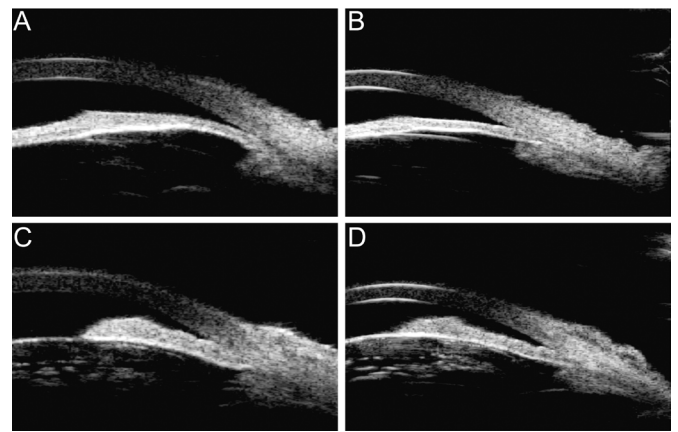
**Case 1** A 79-year-old man was referred from a local clinic to our glaucoma clinic due to a 1-month history of reduced vision and ocular hypertension in both eyes. The patient denied family history of glaucoma and denied other history of diseases. The best corrected visual acuity (BCVA) was 20/40 in both eyes. IOP measurement was 30.0 mm Hg in the right eye and 26.0 mm Hg in the left eye. The axial length was 23.35 mm in the right eye and 23.61 mm in the left eye. Slit lamp examination revealed the central anterior chamber depths were 1.5 corneal thicknesses (CTs) in both eyes. Fundus examination revealed a cup/disc ratios of approximately 0.4 and 0.3 for the right and left eye, respectively. Ultrasound biomicroscopy (UBM) images revealed anterior chamber angle was closed in three quadrants in the right eye and anterior chamber angle was closed in one quadrant in the left eye. The reliable 24-2 Humphrey visual field stimulus III revealed an inferior nasal step and retinal nerve fiber layer defects were observed in the superotemporal and inferotemporal regions through optical coherence tomography (OCT) imaging in the right eye. He was diagnosed with PACG according to the clinical history, symptoms and ophthalmologic examination. The patient had undergone bilateral LPI followed by carteolol hydrochloride (Mikelan<sup>®</sup>, 2%, Otsuka Pharmaceutical, Tianjin, China) and brimonidine tartrate (ALPHAGAN<sup>®</sup>, 0.2%, Allergan Pharmaceuticals Ireland, Ireland) twice daily in both eyes with normal IOP. Six months later, visual acuity did not show any improvement and the anterior chamber depths remained shallow. Based on UBM examination, the anterior chamber depth was 1.52 mm in the right eye and 1.77 mm in the left eye (Figure 1A, 1B). UBM showed the anterior chamber angles were closed without plateau iris configuration or thick peripheral iris roll (Figure 2A, 2B). Subsequently, the patient received bilateral phacoemulsification and TECNIS



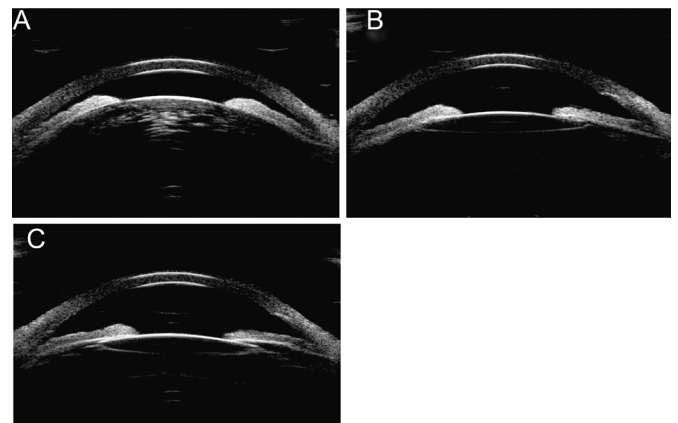
**Figure 1** Ultrasound biomicroscopy images of case 1 The anterior segment in the right eye (A) and left eye (B) before cataract surgery; The anterior segment in the right eye (C), left eye (D), one and a half years after cataract surgery combined with goniosynechialysis; The anterior segment in the right eye (E) and left eye (F) one week after surgical iridozonulohyaloidvitrectomy.

ZA9003 IOL (Abbott Medical Optics Inc., Santa Ana, CA, USA. IOL refractive power was +21.0 D and +19.5 D of the right and left eye, respectively) implantation combined with GSL. Postoperative treatment consisted of tropicamide phenylephrine (Mydrin®-P, 0.5% and 0.5%, Santen Pharmaceutical, Osaka, Japan) administered once per night for 1mo after surgery.

One and a half years after the operation, the patient still presented with decreased visual acuity and further visual impairment. The BCVA was 20/67 in both eyes. On UBM examination, the anterior chambers remained shallow with the depths of 1.74 mm in the right eye and 1.81 mm in the left eye (Figure 1C, 1D). The patient still needed to take carteolol hydrochloride and brimonidine tartrate twice daily in both eyes to provide sufficient IOP control. The cup/disc ratios were increased to approximately 0.9 and 0.6 in the right and left eye, respectively. Thirty-minute after mydriasis with tropicamide phenylephrine, the central anterior chamber depths were increased from 1.5 CTs to 2.5 CTs in both eyes. Therefore, we considered that partial ciliary block might have contributed to the development of PACG of this patient. To relieve partial ciliary block, surgical iridozonulohyaloidvitrectomy were performed on both eyes. Deepening of the anterior chambers was observed during the procedure. At 1-week follow-up, the anterior chamber depths deepened to 2.71 and 2.95 mm in the right and left eye, respectively. UBM showed deeper



**Figure 2** Ultrasound biomicroscopy images A and B: The anterior chambers were closed without plateau iris configuration, thick peripheral iris roll or exaggerated lens vault before cataract surgery in case 1; C and D: The anterior chamber was closed without plateau iris configuration or thick peripheral iris roll before cataract surgery in case 2.



**Figure 3** Ultrasound biomicroscopy images in the left eye of case 2 A: The anterior segment before cataract surgery; B: The anterior segment six months after cataract surgery combined with goniosynechialysis; C: The anterior segment one week after yttrium aluminium garnet laser iridozonulohyaloidotomy.

anterior chambers with backward movement of the lens-iris diaphragms compared with the pre-operation condition (Figure 1E, 1F). The IOP was 7.0 mm Hg in the right eye and 8.0 mm Hg in the left eye with no anti-glaucoma medication. At 2mo after the procedure, the anterior chamber depths gradually increased to 2.79 mm in the right eye and 3.10 mm in the left eye. The BCVA improved to 20/33 in the right eye and 20/50 in the left eye.

**Case 2** An 80-year-old woman referred to our clinic for further treatment with a complaint of reduced vision for about 1y in the left eye. The patient was diagnosed as “glaucoma” by local hospital and had undergone LPI in both eyes 6y before the visit. The patient denied family history of glaucoma. On examination, the BCVA was 20/25 in the right eye and 20/250 in the left eye. The IOP was 18.6 mm Hg in the right eye

and 22.2 mm Hg in the left eye with carteolol hydrochloride and brimonidine tartrate twice daily. Slit lamp examination revealed patent peripheral iris incisions and the central anterior chamber depths were 1.5 CTs in both eyes. UBM images showed the anterior chamber angles were closed without plateau iris configuration or thick peripheral iris roll in the left eye (Figure 2C, 2D). The anterior chamber depth was 1.31 and 1.12 mm by UBM (Figure 3A) with the axial length of 21.80 and 21.73 mm in the right and left eye, respectively. The inferior nasal step visual field defect and superotemporal retinal nerve fiber layer defects were observed in the left eye. She was diagnosed with PACG according to the medical history, surgical history and ophthalmologic examination. Subsequently the patient received phacoemulsification and TECNIS ZA9003 IOL (IOL refractive power was +24.0 D) implantation combined with GSL in the left eye. Post-operative treatment consisted of tropicamide phenylephrine administered once per night for 1mo after surgery. At 1-month follow-up, the BCVA improved to 20/20 and the IOP decreased to 18.0 mm Hg with no anti-glaucoma medication. However, the anterior chamber depth was not significantly deepened as in other patients with cataract surgery, but only increased to 1.84 mm. Six months later, the IOP was 20.0 mm Hg with no anti-glaucoma medication. However, on UBM examination, the patient's anterior chamber remained shallow of 2.05 mm (Figure 3B). Yttrium aluminium garnet (YAG) laser iridozonulohyaloidotomy was performed to disrupt the anterior hyaloid face, so that the anterior vitreous could communicate with anterior chamber. At 1-week follow-up, UBM showed the anterior chamber depth deepened to 2.36 mm with backward movement of the lens-iris diaphragms (Figure 3C). IOP was within normal limits with no anti-glaucoma medication. During 2mo after the procedure, the anterior chamber depth gradually deepened to 2.84 mm.

In conclusion, the mechanisms of PACG have not yet been completely elucidated. Kwon<sup>[5]</sup> classified mechanisms of angle-closure into four categories: 1) pupillary block (35%); 2) plateau iris configuration (23%); 3) thick peripheral iris roll (26%); and 4) exaggerated lens vault (17%). The majority of PACG cases in China are caused by a combination of multiple mechanisms, including pupillary block factors and nonpupillary block factors<sup>[6]</sup>. Lens plays a key role in PACG pathogenesis, and anterior chamber depth can be significantly increased by lens extraction alone, accompanying the IOP reduction and the anterior chamber angle widening<sup>[7]</sup>. A retrospective study has shown that cataract surgery contributes to widening the anterior chamber angle by decreasing lens volume, relieving pupillary block, and attenuating the anterior positioning of ciliary processes in the eyes with PACG<sup>[8]</sup>. However, the results about persistent shallow anterior chamber

depth after surgery are different from previous studies<sup>[7-8]</sup>. Another study showed that in patients with shallow anterior chamber, anterior chamber depth didn't recover to normal level compared with patients of normal anterior chamber after phacoemulsification by anterior segment swept-source OCT<sup>[9]</sup>. But the data of ciliary body structure was not mentioned in the study<sup>[9]</sup>, due to OCT could not measure the ciliary body as UBM. The UBM images in this study can directly reflect the state of ciliary body. In cases reported in this study, the UBM examination showed no feature of plateau iris configuration or thick peripheral iris roll before surgery. In addition, LPI could eliminate the relative pupillary block. Theoretically, phacoemulsification and IOL implantation combined with GSL could relieve most risk factors in these two patients, especially on exaggerated lens vault and pupillary block. However, it was the fact that the anterior chambers remained shallow after phacoemulsification surgery combined with GSL.

Furthermore, the proposed mechanisms of malignant glaucoma (MG), which is also called ciliary block glaucoma and aqueous misdirection, include ciliolenticular block presumably caused by anterior movement of the lens-iris diaphragm, abnormality of vitreous flow, and expansion of choroidal<sup>[10-12]</sup>. A retrospective case series study reported that MG developed in 3 of 20 PACG eyes after cataract surgery and presumed that MG could be precipitated by preoperative shallow anterior chambers in these eyes, but the report did not specify for medical history or the value of anterior chamber depth<sup>[13]</sup>. An acute episode of MG can occur during cataract surgery and resolve within a few hours sometimes, while the chronic condition can persist and lead to chronic angle-closure<sup>[12]</sup>. The IOP increases with shallowing of the peripheral and central anterior chambers has been reported to occur around  $3.5 \pm 2.7$  wk after cataract surgery<sup>[10]</sup>. But in the two cases, instead of secondary to cataract surgery, persistent shallow anterior chamber occurred before and after cataract surgery also suggested there might be potential structural abnormalities, which to some extent played a role in the development of PACG. Compared with most of the previous studies which focused on aqueous misdirection or ciliolenticular block secondary to surgery<sup>[14-15]</sup>, we put forward the concept that partial ciliary block is caused by the natural anatomical structure of PACG patients rather than surgery.

A step-by-step approach to re-establishing the communication between the anterior chamber and vitreous cavity for MG patients was initiated with aqueous suppressants and cycloplegics, followed by YAG laseriridozonulohyaloidotomy, then anterior chamber reformation and finally, surgical iridozonulohyaloidovitreotomy<sup>[10,13]</sup>. In cases 1 and 2, the fact that dramatic deepening of the anterior chambers with backward movement of the lens-iris diaphragms after

surgical iridozonulohyaloidvitrectomy or YAG laser iridozonulohyaloidotomy provides further evidence for the existence of the partial ciliary block. One week or even two months after operation in case 2, the depth of the anterior chamber gradually deepened, suggesting that it may take a long time to alleviate partial ciliary block. According to the current result, we speculate that the partial ciliary block contributes to the development in some of the PACG patients which could not be eradicated completely by phacoemulsification and IOL implantation combined with GSL.

In conclusion, we propose that in addition to existing mechanisms of PACG, the partial ciliary block may also be one of the primary factors in some of the PACG patients. However, imaging techniques including anterior segment OCT and UBM seem to be insufficiently sensitive for reliably detecting ciliary block because of inherent problems. Early detection of the ciliary block and timely management can reduce the risk of persistent shallow anterior chamber. Therefore, novel and objective anterior segment imaging techniques were needed to recognize this condition in PACG patients.

#### ACKNOWLEDGEMENTS

**Foundations:** Supported by National Natural Science Foundation of China (No.61634006); the National Key R&D Program of China (No.2020YFC2008200); the Beijing Science and Technology Plan Project (No.Z191100007619045).

**Conflicts of Interest:** Yang KY, None; Liang ZQ, None; Chen XZ, None; Wu HJ, None.

#### REFERENCES

- 1 Sun X, Dai Y, Chen Y, Yu DY, Cringle SJ, Chen J, Kong X, Wang X, Jiang C. Primary angle closure glaucoma: what we know and what we don't know. *Prog Retin Eye Res* 2017;57:26-45.
- 2 Hayashi K. Changes in anterior chamber angle width and depth after intraocular lens implantation in eyes with glaucoma. *Ophthalmology* 2000;107(4):698-703.
- 3 Azuara-Blanco A. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): a randomised controlled trial. *Lancet* 2016;388(10052):1389-1397.
- 4 Shao TT, Hong JX, Xu JJ, Le QH, Wang JJ, Qian SH. Anterior chamber angle assessment by anterior-segment optical coherence tomography after phacoemulsification with or without goniosynechialysis in patients with primary angle closure glaucoma. *J Glaucoma* 2015;24(9):647-655.
- 5 Kwon J. Long-term changes in anterior segment characteristics of eyes with different primary angle-closure mechanisms. *Am J Ophthalmol* 2018;191:54-63.
- 6 Wang FL, Wang DB, Wang L. Exploring the occurrence mechanisms of acute primary angle closure by comparative analysis of ultrasound biomicroscopic data of the attack and fellow eyes. *Biomed Res Int* 2020;2020:8487907.
- 7 Senthil S, Rao HL, Choudhari N, Garudadri C. Phacoemulsification versus Phacotrabeculectomy in Medically Controlled Primary Angle Closure Glaucoma with Cataract in an Indian Cohort: a randomized controlled trial. *Int Ophthalmol* 2022;42(1):35-45.
- 8 Nonaka A. Angle widening and alteration of ciliary process configuration after cataract surgery for primary angle closure. *Ophthalmology* 2006;113(3):437-441.
- 9 Zheng Q, Hu M, Li ZL, Chang PJ, Zhao YE. Assessment of anterior chamber angle changes after phacoemulsification with swept-source OCT. *Int J Ophthalmol* 2021;14(10):1527-1532.
- 10 Varma DK. Malignant glaucoma after cataract surgery. *J Cataract Refract Surg* 2014;40(11):1843-1849.
- 11 Byrnes GA. Vitrectomy for ciliary block (malignant) glaucoma. *Ophthalmology* 1995;102(9):1308-1311.
- 12 Schmidt DC, Kessel L, Pedersen KB, Villumsen JE, Bach-Holm D. Pars Plana vitrectomy combined with hyaloido-zonula-iridectomy in treatment of patients with chronic aqueous misdirection: a systematic literature review and case series. *Acta Ophthalmol* 2021;99(3):251-259.
- 13 Raj S, Thattaruthody F, Joshi G, Seth NG, Kaushik S, Pandav SS. Treatment outcomes and efficacy of pars Plana vitrectomy-hyaloidotomy-zonulectomy-iridotomies in malignant glaucoma. *Eur J Ophthalmol* 2021;31(1):234-239.
- 14 Wang QW, Zuo CG, Li J, Lin XS, Chen W, Zhu QL, Zhou FQ, Lin HT, Chen WR. Effectiveness of surgical management of malignant glaucoma in phakic eyes. *Int J Ophthalmol* 2022;15(1):65-70.
- 15 Xu QQ, Wang WW, Zhu J, Liu JR. An unusual case of malignant glaucoma with ciliary detachment. *Int J Ophthalmol* 2021;14(12):1988-1992.