

Analysis of Retinal Nerve Fibre Layer Changes in Cases of Phacomorphic Angle Closure Post Phacoemulsification

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ABSTRACT

Introduction: To investigate the retinal nerve fibre layer (RNFL) changes after an acute attack of phacomorphic angle closure. **Methods:** This prospective study involved 25 cases of phacomorphic angle closure that underwent phacoemulsification and intraocular lens insertion after intraocular pressure lowering. Apart from visual acuity and intraocular pressure (IOP), RNFL thickness was measured by optical coherence tomography (OCT) at 3–6 months post attack. **Result:** All cases had mean phacomorphic duration of <10 days. Postoperatively, best correct Snellen visual acuity was 0.42 ± 0.23 and IOP at 6 months was 13.92 ± 2.41 mmHg. There was no difference RNFL between the attack and contralateral eye at 3 months post attack (both $p = 0.102$). At 6 months post attack, there was significant thinning in the average ($p < 0.001$), superior ($p = < 0.001$), and inferior ($p = 0.001$) RNFL. Patients with <5 days duration of phacomorphic angle closure are likely to have reasonable postoperative vision. **Conclusion:** An acute episode of phacomorphic angle closure can trigger an accelerated RNFL thinning despite normal IOP and open angles, most noticeable in the superior and inferior quadrants, occurring between 3 and 6 months post attack. There is a need of long term follow up of such patients.

Key Words: Retinal nerve fibre layer, Optical coherence tomography, Phacomorphic angle closure, Cup-disc ratio.

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INTRODUCTION


Phacomorphic glaucoma is secondary angle-closure glaucoma due to an increase in lens thickness which can be due to an advanced cataract or a rapidly intumescent lens. There is sudden rise in IOP compromising the function of the optic nerve leading to irreversible visual loss if not treated in time. It is peculiar to developing countries like India, (constitutes 3.91% of all cataract operations done) where the incidence of cataract far exceeds the total number of surgeries.^[1-5]

Patients come with complaints of pain and redness in an eye which had a progressive painless diminution of vision. On

examination, there is injection of conjunctival and episcleral vessels, corneal edema, shallow anterior chamber, an intumescent cataractous lens.

Primary management includes lowering of IOP followed by the definitive treatment that is cataract extraction. But recent evidence indicates that progression can continue despite effective lowering of IOP.^[6-11]

The term phacomorphic glaucoma is used if there is resultant GON which has been previously quantified and reported using visual field (VF) assessments or clinical cup-disc ratio

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monitoring.^[12] However, both of these parameters are variable and not entirely objective especially when phacomorphic angle closure often affects an elderly population where dementia and neglect are common.^[13] In addition, studies in acute primary angle closure (APAC) have shown that more than half of the patients with a single attack can have no visual field defects.^[14] On the other hand, retinal nerve fiber layer measurements can detect early GON as its damage often precedes visual field loss.^[15]

RNFL parameters measured by optical coherence tomography (OCT) have been demonstrated to provide accurate information for glaucoma diagnosis and sensitive method for disease progression.^[16]

We therefore designed a formal prospective observational study to investigate the long-term effect of acute phacomorphic attack on RNFL using OCT.

METHODS

This is a prospective non-randomized (longitudinal), observational study. Consecutive patients with first episode of acute (<10 days) phacomorphic angle closure, IOP more than 21 mm hg^[17,12,7], diagnosed on the basis of presence of an intumescent cataract and sign of acute angle closure in the index eye and open angle in contralateral eye as determined by gonioscopy were recruited in this study after the informed consent. Time frame being November 2015 to October 2016. Phacomorphic angle closure where peripheral anterior synechiae (PAS) detected on gonioscopy and patients with any comorbidity, which affects RNFL thickness. (High myopia, diabetic retinopathy, ischaemic retinopathy), non-cooperative, one eyed, known case of glaucoma were excluded from the study

Ethical Issue: The study was approved by the scientific and ethical committee of Sahai Hospital and Research Centre, Jaipur, Rajasthan.

Methodology: All patients underwent a targeted ocular and systemic history taking. Patients with <= 10 days duration of attack were included. (Patients were divided in two groups: Group A less than equal to 5 days duration; group B 6-10 days duration; to assess the correlation between visual acuity and duration of attack). All patients initially received IOP lowering treatment to achieve IOP below 25 mmHg followed by phaco-emulsification with posterior chamber intraocular lens (PCIOL) insertion under topical anaesthesia (TA) by single surgeon at our centre within 3 days of presentation to our clinic. All glaucoma medications were stopped after cataract extraction. Patients were followed up on day 1, day 5, 1 month, 3 months and 6 months postoperatively and were subjected to the following examinations: Best corrected visual acuity (BCVA) by Snellen chart on each visit and converted to Logarithm of Minimal Angle of Resolution (LogMAR) units for statistical analysis. IOP measured with Goldman applanation tonometry on each visit, angle measured by gonioscopy at 3 months post attack done by single examiner, Optical coherence tomography was used to measure RNFL thickness.

RESULTS

Total 25 patients were included in the study with mean age of presentation being 67.68±6.23 years and mean duration of attack was 5.00±2.64 days. Out of 25 patients 16 were females and 9 were males. (F: M=1.77:1). The presenting IOP was 40.12± 8.06 mmHg. The postoperative IOP at 6 months was 13.92 ± 2.41 mmHg without any glaucoma medication. All cases had an open trabecular-iris angle configuration on gonioscopy.

Mean VA at presentation was light perception (PL) which improved to 0.42±0.23 at final follow up. Our patients had a final mean BCVA of 0.32±0.14 in group of patients when duration of attack was less than equals to 5 days (group A) and 0.58±0.26 in group of patients when duration of attack was more than 5 days but less than 10 days (group B) (p<0.006). In group A 86.66% (n=13) had VA of 6/12 or better at final follow up, while in group B patient 40% (n=4) had VA of 6/12 or better

At 3 months post attack, there was no significant difference between the average RNFL of the eye with phacomorphic angle closure (105.77 ± 13.538µm) and the contralateral eyes (101.71 ± 9.15 µm) (p = 0.102). Analyses of each of the individual quadrants again showed no difference between the two eyes (all p > 0.05).

However, at 6 months post attack, the average RNFL of the phacomorphic eye had progressive thinning from 105.77 ± 13.38 µm at 3 months to 97.12 ± 12.32 µm at 6months (p < 0.001). Quadrant analyses showed significant thinning in the superior (127.52 ± 13.53 to 113.08 ± 13.77 µm, p =<0.001) and inferior quadrants (129.08 ± 18.98 to 112.40 ± 16.62 µm, p = 0.001) but there was no significant progressive thinning in the nasal (p = 0.161) or temporal (p = 0.161) quadrants (Tables 1, 2,3,4).

Table 1: OCT RNFL 3 month (PE vs CE)

OCT RNFL	PE		CE		t	p
	Mean	SD	Mean	SD		
Superior	127.52	13.53	122.36	11.52	1.922	0.067
Inferior	129.08	18.98	126.00	19.03	0.776	0.445
Nasal	84.60	18.45	80.64	9.30	1.027	0.315
Temporal	81.88	15.76	77.84	10.24	1.111	0.278

PE: Phacomorphic eye; CE: Contralateral Eye

Table 2: OCT RNFL 6 month (PE vs CE)

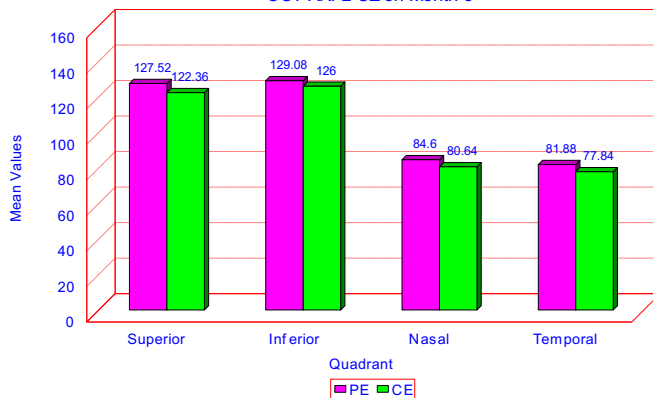
OCT RNFL	PE		CE		t	p
	Mean	SD	Mean	SD		
Superior	113.08	13.77	120.32	10.72	2.806	0.010
Inferior	112.40	16.62	123.36	20.59	3.450	0.002
Nasal	82.16	18.56	77.64	12.10	1.016	0.320
Temporal	79.76	15.02	75.12	9.61	1.242	0.226

Table 3: OCT RNFL PE at 3 month vs 6 months

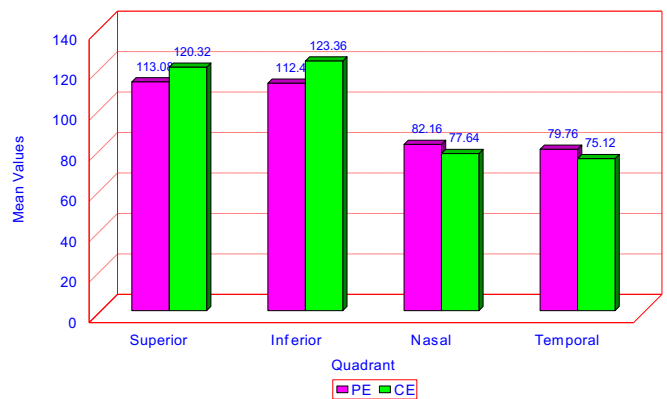
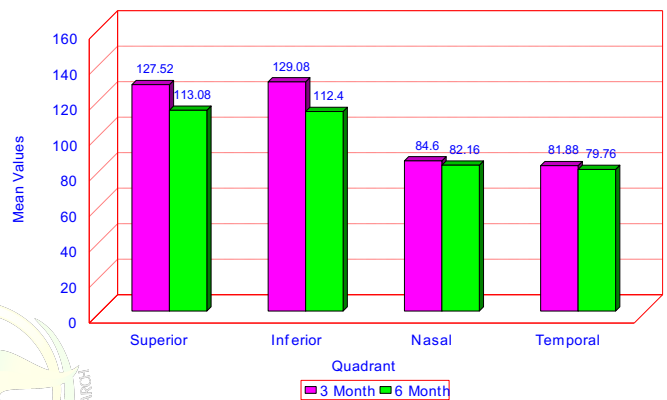
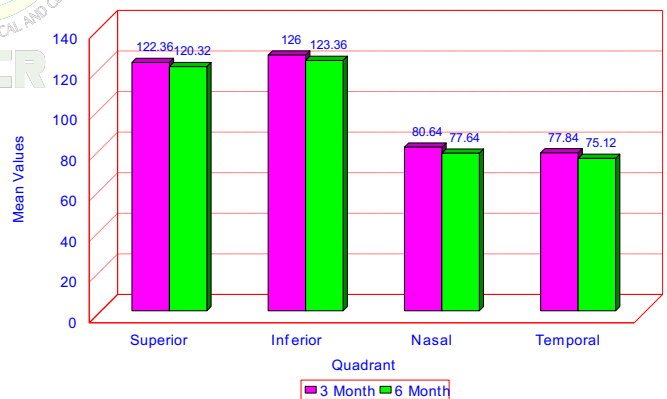
OCT RNFL	3 Month		6 Month		t	p
	Mean	SD	Mean	SD		
Superior	127.52	13.53	13.08	13.77	5.759	<0.001
Inferior	129.08	18.98	112.40	16.62	5.601	<0.001
Nasal	84.60	18.45	82.16	18.56	1.448	0.161
Temporal	81.88	15.76	79.76	15.02	1.447	0.161
Average	105.77	13.38	97.12	12.32	5.904	<0.001

Table 4: OCT RNFL CE at 3 month vs 6 months

OCT RNFL	3 Month		6 Month		t	p
	Mean	SD	Mean	SD		
Superior	122.36	11.52	120.32	10.72	1.086	0.288
Inferior	126.00	19.03	123.36	20.59	1.634	0.115
Nasal	80.64	9.30	77.64	12.10	1.596	0.124
Temporal	77.84	10.24	75.12	9.61	1.231	0.230

Graph 1 : Statistical analysis of OCT RNFL PE in relation to OCT RNFL CE on Month 3

but that a glaucomatous process for more than 5 days was associated with poorer visual outcome.

Graph 2 : OCT RNFL 6 month (PE vs CE)**Graph 3 : OCT RNFL PE at 3 month vs 6 month****Graph 3 : OCT RNFL CE at 3 month vs 6 month**

DISCUSSION

Phacomorphic glaucoma combines two of the most common causes of visual impairment in the elderly^[18] and the reversibility of this acute condition makes it a worthwhile topic of study. To the best of our knowledge this study is first from Indian population evaluating OCT RNFL changes, post phacoemulsification after an acute episode of phacomorphic angle closure.

In our study mean age of presentation was 67.68 ± 6.23 years with female preponderance (Female to male ratio of 1.77:1) may be due to socioeconomic constraints. It was consistent with other studies.^[1,3,4,17,13] with increasing age more mature cataracts develop and age is also a risk factor for primary angle-closure glaucoma, hence these patients at increased risk from having narrow angles.

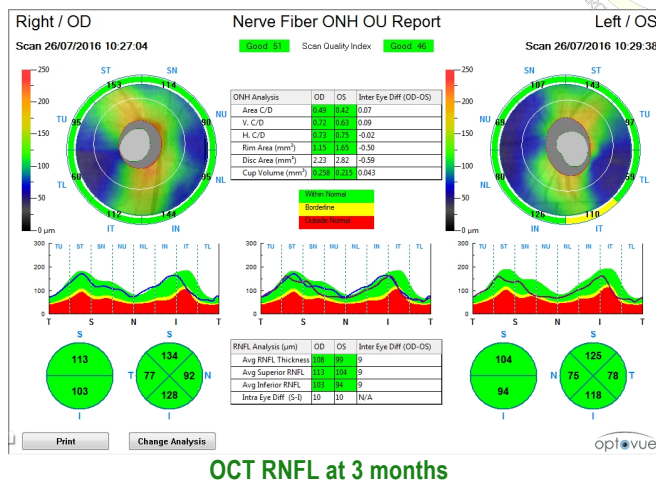
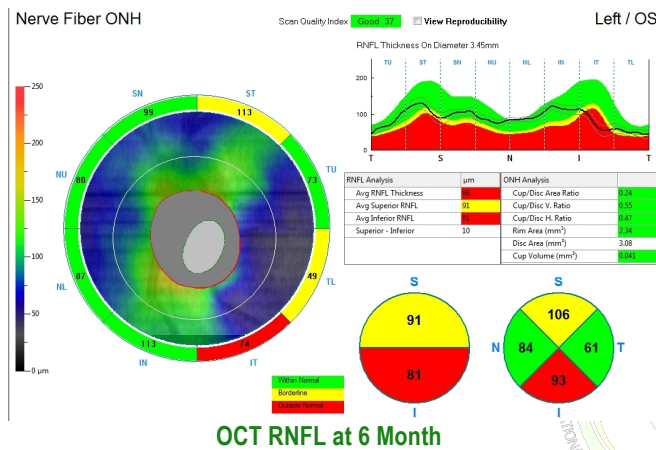
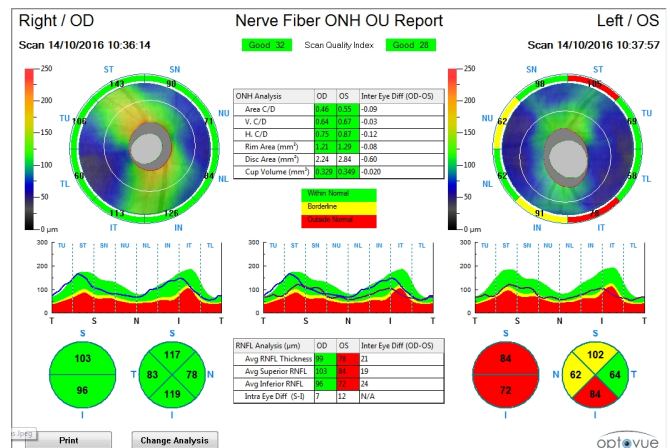
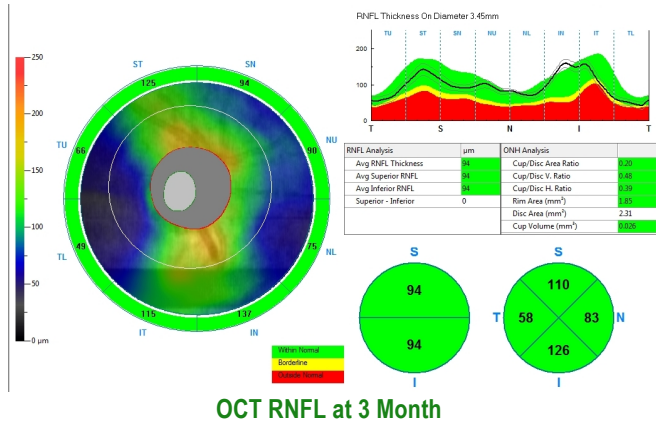
Mean duration of attack was 5.00 ± 2.64 days. The major reasons for late presentation were no escort, poverty, fear of surgery, lack of awareness multiple medical co-morbidities. Various studies have associated poor visual outcomes with a longer duration of phacomorphic attack.^[6,12,13] We found that 68 % of our patients had final visual acuity of 6/12 or better

Thus, as the duration of attack increased there was less recovery of visual acuity. Reasons may include decreased corneal endothelial cell count, spherical aberration from a fixed pupil, glaucomatous optic neuropathy, and other ocular comorbidities such as macular degeneration, in this elderly population who frequently sought care only after a significant delay.^[7] Corneal endothelial cell loss following an attack was reported to be 15%.^[3]

In our study IOP at final visit was 13.92 ± 2.41 mmHg. 100% of our cases had IOP <21 mm Hg without any additional anti-glaucoma treatment during the follow-up of 6 months. In all the cases, cataract extraction alone was sufficient to lower the IOP to <21 mm Hg as the primary pathology is in the mechanical anterior displacement of the intumescent cataract rather than in the trabecular meshwork. However,

our study was time bound studies with follow up period of 6 months only. All patients had open angle configuration as seen by gonioscopy (Shaffer's grade 3).

intumescent cataract, glaucomatous optic neuropathy was an ongoing progress that took place between 3 and 9 months after the initial attack. This study was conducted on 10 patients.



As expected, cataract extraction following phacomorphic angle-closure deepens the angle: 3 years following cataract extraction, the mean Shaffer grade of 100 eyes was 3.^[12] OCT RNFL thickness measurement is our main interest of study. We find a single study on Optical Coherence Tomography (OCT) analysis of the optic nerve head RNFL thickness in ten patients following an attack by Lee et al.^[14] Lee reported that three months after the attack, the average RNFL thickness was statistically similar in the involved and fellow eyes. At 9 months, significant thinning had occurred in the eye with phacomorphic angle-closure. The thinning was worse in the superior and inferior quadrants. They have demonstrated that despite the definitive removal of the

In our study, we demonstrated that thinning took place even before 9 months i.e. between 3 and 6 months. Studies involving APAC have used SLP to demonstrate that RNFL can be thinned after the attack. But progressive RNFL thinning in primary acute angle closure may not all be attributed to the acute rise in IOP as this group of patients will have had narrow drainage angles for certain duration and the RNFL thinning may represent damage from previous intermittent angle closures or a chronic angle closure in evolution. On the other hand, in phacomorphic angle closure, the pathology is in the sudden anterior bulging of the swollen cataract, thus, the GON that follows a phacomorphic attack is possibly attributed to the acute IOP rise. This could be explained by the experiment of Yoles and Schwartz^[18] who suggested that GON progression can occur even after elimination of the acute rise in IOP as a result of secondary apoptosis of healthy neurons bathed in the degenerative milieu created by the damaged neurons from the acute event.

The other possibility for GON progression is a secondary angle closure that develops after the phacomorphic attack but all our cases had IOP < 21 mmHg during follow-up with open angle configurations on gonioscopy. Therefore, we are more inclined with the postulation that the initial optic nerve hypoperfusion from the phacomorphic attack induced cellular inflammatory cytokines and free radicals that led to progressive ganglion cell damage even after the initial phacomorphic angle closure resolved. Regarding the use of VF in the assessment post phacomorphic angle closure, a number of patients lacked the coordination to produce a reliable VF. Furthermore, the results produced at 6 months in 6 patients post attack failed to demonstrate any significant difference between the phacomorphic and contralateral eye but there was already significant RNFL thinning detected on OCT. Lee et al faced the same problem, the mean deviation (MD) in their study was -5.8 ± 3.7 decibels (db) and the PSD was

4.2 ± 3.0 db. There was no significant difference in the PSD between the attack (4.2 ± 3.0 db) and contralateral eye (3.1 ± 1.1 db) ($p = 0.7$). There was also no significant correlation between the RNFL thickness on OCT and the PSD on VF ($p = 0.2$).

CONCLUSION

Hence our study demonstrated that there is progressive RNFL thinning going on despite of removal of cause of raised IOP (cataract). The effect was seen somewhere between 3 months and 6 months post attack in superior and inferior quadrant.

REFERENCES

- Pradhan D, Hennig A, Kumar J, Foster A. A prospective study of 413 cases of lens-induced glaucoma in Nepal. *Indian J Ophthalmol.* 2001; 49:103-07.
- McKibbin M, Gupta A, Atkins AD. J Cataract extraction and intraocular lens implantation in eyes with phacomorphic or phacolytic glaucoma. *Cataract Refract Surg.* 1996; 22:633-36.
- Angra SK, Pradhan R, Garg SP. Cataract induced glaucoma: An insight into management *Indian J Ophthalmol.* 1991; 39:97-101.
- Jain IS, Gupta A, Dogra MR, Gangwar DN, Dhir SP. Phacomorphic glaucoma: Management and visual prognosis. *Indian J Ophthalmol.* 1983; 31:648-53.
- Mapstone R. Closed-angle glaucoma: Theoretical considerations. *Br J Ophthalmol.* 1974; 58:36-40.
- Prajna NV, Ramakrishnan R, Krishnadas R, Manoharan N. Lens induced glaucomas--visual results and risk factors for nal visual acuity. *Indian J Ophthalmol* 1996; 44: 149-155.
- Schumer RA, Camras CB, Mandahl AK. Putative side effects of prostaglandin analogs. *Surv Ophthalmol* 2002; 47 Suppl 1: S219.
- Ritch R, Tham CC, Lam DS. Argon laser peripheral iridoplasty (ALPI): an update. *Surv Ophthalmol* 2007; 52:279-288.
- Rijal AP, Karki DB. Visual outcome and IOP control after cataract surgery in lens induced glaucomas. *Kathmandu Univ Med J (KUMJ)* 2006; 4:30-33.
- Lee JW, Lai JS, Lam RF, Wong BK, Yick DW, et al. Retrospective analysis of the risk factors for developing phacomorphic glaucoma. *Indian J Ophthalmol* 2011; 59:471-474.
- Tham CC, Lai JS, Poon AS, Chan JC, Lam SW, et al. Immediate argon laser peripheral iridoplasty (ALPI) as initial treatment for acute phacomorphic angle-closure (phacomorphic glaucoma) before cataract extraction: a preliminary study. *Eye (Lond)* 2005; 19: 778-783.
- Lee JW, Lai JS, Yick DW, Tse RK. Retrospective case series on the long- term visual and intraocular pressure outcomes of phacomorphic glaucoma. *Eye (Lond)* 2010; 24:1675-1680.
- Yip PP, Leung WY, Hon CY, Ho CK. Argon laser peripheral iridoplasty in the management of phacomorphic glaucoma. *Ophthalmic Surg Lasers Imaging* 2005; 36: 286-291.
- Lee JW, Lai JS, Yick DW, Yuen CY. Prospective study on retinal nerve bre layer changes after an acute episode of phacomorphic angle closure. *Int Ophthalmol* 2012 32:577-582.
- Aung T, Husain R, Gazzard G, et al Changes in retinal nerve fiber layer thickness after primary acute angle closure. *Ophthalmology.* 2004;111(8):1475-1479.
- Tsai JC, Chang HW. Scanning laser polarimetry in patients with acute angle-closure glaucoma. *Eye.* 2004;18:9-14.
- Sowka J. Phacomorphic glaucoma: case and review. *Optometry* 2006; 77:586-589.
- Yoles E, Schwart Z. Potential neuroprotective therapy for glaucomatous optic neuropathy. *SurvOphthalmol.* 1998; 42:367-372.
- Dada T, Kumar S, Gadia R, Aggarwal A, Gupta V, et al. Sutureless single-port transconjunctival pars plana limited vitrectomy combined with phacoemulsi cation for management of phacomorphic glaucoma. *J Cataract Refract Surg* 2007; 33: 951-954.

