Clinical outcomes of clear lens extraction in eyes with primary angle closure

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PURPOSE: To evaluate the effect of clear lens extraction (CLE) on intraocular pressure (IOP) and the anterior chamber angle in primary angle closure after laser peripheral iridotomy (LPI).

SETTING: Tertiary eyecare center at a university hospital, New Delhi, India.

DESIGN: Prospective case series.

METHODS: The study included eyes with primary angle closure and an IOP over 25.0 mm Hg more than 8 weeks after LPI. All eyes had CLE by phacoemulsification. Absolute success was defined as an IOP less than 18.0 mm Hg without medications at 12 months.

RESULTS: In 44 eyes (24 women, 20 men; mean age 57.2 years ± 4.2 [SD]), the mean preoperative IOP of 27.1 ± 1.55 mm Hg decreased to 13.2 ± 1.12 mm Hg at 12 months ($P < .0001$). The angle opening distance at 500 μm increased from baseline values at 0 degrees (from 0.104 ± 0.015 mm to 0.31 ± 0.013 mm) and 180 degrees (from 0.202 ± 0.008 mm to 0.412 ± 0.012 mm). The trabecular iris angle also increased at 0 degrees (from 9.3 ± 3.2 degrees to 32.7 ± 5.6 degrees) and 180 degrees (from 9.12 ± 3.2 degrees to 31.7 ± 5.6 degrees) (all $P < .0001$). In multivariate analysis, the preoperative IOP was the strongest determinant of IOP change ($R^2 = 0.69$, $P < .0001$). Absolute success was achieved in 38 eyes (86.3%).

CONCLUSION: Clear lens extraction led to a significant reduction in IOP, a widening of the anterior chamber angle, and a reduced need for ocular hypotensive medications in eyes with primary angle closure and persistently raised IOP after LPI.

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Primary angle closure has been defined as an eye with an occludable drainage angle and features indicating trabecular obstruction by the peripheral iris, such as peripheral anterior synechiae, elevated intraocular pressure (IOP), iris whirling, glaukomflecken, and excessive pigment deposition on the trabecular surface, without glaucomatous optic neuropathy.[1]

It has been reported that one third of eyes with primary angle closure and ocular hypertension develop primary angle-closure glaucoma (PACG).[2,3] According to estimates in 2010, PACG affects approximately 15 million people and is responsible for one half of glaucoma-related blindness.[4] Because PACG has a high population attributable risk percentage, a significant proportion of PACG-related blindness is preventable if the disease is treated in an early stage.[4–7]

The crystalline lens plays a pivotal role in the pathogenesis of primary angle closure. Eyes with primary angle closure have a thicker, more anteriorly positioned crystalline lens than normal eyes.[8–16] Many studies[17–21] have evaluated the effects of lens extraction on IOP control and angle widening in eyes with established PACG.

Conventional management of primary angle closure starts with laser peripheral iridotomy (LPI), which effectively prevents acute angle-closure attacks and slows the progression of primary angle closure to the irreversible stage of glaucomatous optic neuropathy (ie, PACG). However, reports suggest that LPI is not universally effective in preventing asymptomatic IOP elevations in the long term and that the disease could continue to progress despite a patent LPI.[22–25] Therefore, medical and/or surgical intervention might

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be required if the LPI fails to reduce the IOP. Removing the crystalline lens can deepen the anterior chamber and relieve crowding of the angle, an effect that should occur irrespective of the cataract status of the lens. Deepening of the anterior chamber and widening of angles after clear lens extraction (CLE) in PACG have been clearly demonstrated.[26,27] A recent review discussed the effectiveness of this procedure in eyes with primary angle closure[26] and summarized that early lens extraction might be therapeutic. However, there are no studies of the clinical outcomes of CLE in primary angle closure to support this hypothesis.

The present study evaluated the effect of CLE on IOP control and on anterior chamber angle parameters in eyes with primary angle closure and persistently raised IOP in which LPI had been performed.

PATIENTS AND METHODS

The study was approved by the Institutional Ethics Committee of the All India Institute of Medical Sciences and adhered to the tenets of Declaration of Helsinki. All patients provided informed written consent and were recruited from the outpatient services of a tertiary eyecare center at a university hospital from July 1, 2011, to December 31, 2013.

The study included phakic eyes of patients older than 50 years with primary angle closure, a corrected distance visual acuity (CDVA) of 20/20 or better with a patent LPI, and an IOP of more than 25.0 mm Hg at least 8 weeks after LPI despite the use of ocular hypotensive medications. Excluded were eyes with PACG, acute primary angle closure, or primary angle closure suspect. One-eyed patients were also excluded.

Primary angle closure was defined as the presence of occludable angles in at least 3 quadrants on gonioscopy (Sussman 4-mirror gonioscope, Ocular Instruments), an elevated IOP, and no evidence of optic nerve damage or nerve fiber layer defect. The preoperative workup included visual acuity measurement, slitlamp biomicroscopy, evaluation of the optic nerve head using a 90.0 diopter lens, gonioscopy, applanation tonometry, A-mode contact ultrasonography (Sonomed A2500, Haag-Streit), keratometry, perimetry (Humphrey Field Analyzer II-*i*, Carl Zeiss Meditec AG), and anterior segment optical coherence tomography (AS-OCT) (Visante, Carl Zeiss Meditec AG) for evaluating the various angle parameters. The angle parameters evaluated were the anterior chamber depth (ACD) (measured along the posterior corneal surface to the anterior pole of the lens); lens thickness (the distance between the anterior and posterior poles of the lens); the angle-opening distance 500 μm and 750 μm from the scleral spur at 0 and 180 degrees; the distance between the posterior corneal surface and the anterior iris surface (measured on a line perpendicular to the trabecular meshwork 500 μm and 750 μm from the scleral spur); the trabecular iris angle at 0 and 180 degrees (measured with the apex at the iris recess and the arms of the angle passing through a point on the trabecular meshwork 500 μm from the scleral spur and through a point on the iris perpendicularly opposite); the trabecular iris surface area at 0 degrees and 180 degrees (trabecular iris surface area 500 is an area bounded anteriorly by the angle opening distance 500, posteriorly by a line from the scleral spur perpendicular to the plane of the inner scleral wall to the opposing iris, superiorly by the inner corneoscleral wall, and inferiorly by the iris surface); lens vault, defined as the perpendicular distance between the anterior pole of the crystalline lens; and the horizontal line joining the 2 scleral spurs on horizontal AS-OCT scans.

Preoperatively, the number of ocular hypotensive medications that the patients were taking was recorded. Next, the same surgeon (T.D.) performed CLE by phacoemulsification with implantation of a posterior chamber foldable single-piece hydrophobic acrylic intraocular lens (IOL) in the capsular bag.

Postoperatively, a 4-week tapered course of a topical steroid and antibiotic was prescribed for all patients. The preoperative ocular hypotensive agents were discontinued after surgery. The postoperative IOP was recorded at 1 and 3 days, 2 and 4 weeks, and 3, 6, and 12 months. Ocular hypotensive medications were reinstituted for patients in whom the IOP was over 21.0 mm Hg at any follow-up. The postoperative distance and near visual acuities were recorded at 1, 3, 6, and 12 months. Anterior segment OCT was repeated postoperatively at 3, 6, and 12 months.

The primary outcome measure was a change in the IOP from preoperatively to postoperatively. Secondary outcome measures included the preoperative to postoperative change in anterior chamber angle parameters and a reduction in the number of ocular hypotensive medications prescribed. Absolute success was defined as having an IOP less than 18.0 mm Hg without use of ocular hypotensive medication. A qualified success was defined as having an IOP less than 18.0 mm Hg with the use of 1 ocular hypotensive medication.

Data were recorded in Excel software (Microsoft Corp.) and were analyzed using SPSS software (version 11.5, SPSS, Inc.). The paired *t* test was used to analyze quantitative data. Correlations were assessed using the Pearson correlation test and multivariate analysis. Categorical data were analyzed using the chi-square test. A *P* value less than 0.05 was considered statistically significant.

RESULTS

The study comprised 44 eyes of 44 patients. The mean age of the 24 women and 20 men was 57.2 years ± 4.2

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Table 1. Preoperative and postoperative UNVA.

UNVA	Patients (n)	
	Preop	12 Mo Postop
J8	14	0
J10	20	12
J12	8	22
J18	2	7
J24	0	3

J = Jaeger; UNVA = uncorrected near visual acuity

(SD) (range 52 to 64 years). Preoperatively, the mean uncorrected distance visual acuity (UDVA) was 0.23 ± 0.05 logMAR (range 0.17 to 0.60 logMAR) and the mean CDVA, 0.00 ± 0.00 logMAR. All patients had a CDVA of 20/20. Postoperatively, the mean UDVA improved to 0.07 ± 0.06 logMAR ($P < .05$) and no eye had a drop in CDVA during the 4-week to 12-month follow-up period. The postoperative corrected near visual acuity was Jaeger (J) 6 in all eyes at 12 months. The postoperative UNVA worsened statistically significantly ($P = .001$) (Table 1). The mean preoperative axial length was 22.32 ± 0.82 mm (range 21.83 to 24.12 mm). The mean preoperative ACD was 2.40 ± 0.019 mm. The mean lens thickness was 4.92 ± 0.231 mm (range 4.33 to 5.23 mm). There was no change in the optic nerve head parameters, and no eye had a visual field defect at 12 months.

The mean reduction in IOP at 12 months was 14.29 ± 1.83 mm Hg (range 11 to 18 mm Hg). The AS-OCT imaging showed significant deepening of the ACD and significant angle widening postoperatively (Table 2 and Figure 1).

Univariate analysis showed statistically significant negative correlations between lens thickness and the ACD and between lens thickness and the angle opening distance at points 500 μm from the scleral spur; it showed a statistically significant positive correlation between the preoperative IOP and the change in IOP over 12 postoperative months (Figure 2). The mean lens vault was 1.44 ± 0.44 mm (range 1.3 to 1.5 mm). There was a statistically significant negative correlation between lens vault and the angle opening distance. However, statistically insignificant correlations between lens vault and preoperative ACD (negative), lens vault and preoperative IOP (positive), and lens vault and the change in IOP (positive) were noted.

The preoperative IOP showed a statistically significant positive correlation with lens thickness and a statistically significant negative correlation with ACD. The change in IOP showed a statistically significant positive correlation with preoperative IOP and lens thickness and a statistically significant negative correlation with ACD (Table 3).

In the multivariate analysis, the only statistically significant predictors of the change in IOP were preoperative IOP and ACD (adjusted $R^2 = 0.69$, $P = .001$) (Table 4).

Preoperatively, 6 (13.6%) of 44 patients were taking 1 medication, 31 (70.5%) were taking 2 medications, and 7 (15.9%) were taking 3 medications. Postoperatively, all ocular hypotensive medications were

Table 2. Preoperative and postoperative parameters.

Parameter	Mean ± SD				
		Postoperative			
	Preoperative	3 Months	6 Months	12 Months	*P* Value*
IOP (mm Hg)	27.1 ± 1.55	13.8 ± 1.42	13.4 ± 1.17	13.2 ± 1.12	.0001
ACD (mm)	2.40 ± 0.019	3.12 ± 0.028	3.166 ± 0.027	3.17 ± 0.027	.0002
AOD 500 at 0° (mm)	0.104 ± 0.015	0.3 ± 0.005	0.309 ± 0.013	0.31 ± 0.013	.0003
AOD 500 at 180° (mm)	0.202 ± 0.008	0.371 ± 0.008	0.41 ± 0.009	0.412 ± 0.012	.0002
AOD 750 at 0° (mm)	0.172 ± 0.008	0.492 ± 0.013	0.522 ± 0.012	0.534 ± 0.013	.0002
AOD 750 at 180° (mm)	0.214 ± 0.008	0.52 ± 0.008	0.532 ± 0.009	0.544 ± 0.012	.0002
TISA 500 at 0° (mm^2)	0.071 ± 0.004	0.105 ± 0.010	0.122 ± 0.002	0.126 ± 0.004	.0003
TISA 500 at 180° (mm^2)	0.075 ± 0.003	0.113 ± 0.007	0.138 ± 0.004	0.141 ± 0.004	.0003
TISA 750 at 0° (mm^2)	0.115 ± 0.005	0.208 ± 0.005	0.212 ± 0.004	0.222 ± 0.007	.0001
TISA 750 at 180° (mm^2)	0.093 ± 0.015	0.191 ± 0.007	0.208 ± 0.003	0.211 ± 0.006	.0002
TIA at 0°	9.3 ± 3.1	32.1 ± 4.2	32.4 ± 4.2	32.7 ± 5.2	.0002
TIA at 180°	9.12 ± 3.2	31.2 ± 4.2	31.5 ± 4.6	31.7 ± 5.6	.0001

ACD = anterior chamber depth; AOD 500 and AOD 750 at 0° and 180° = angle opening distance at points 500 μm and 750 μm from the scleral spur at 0° and 180° angles; TIA at 0° and 180° = trabecular iris angle at 0° and 180°; TISA 500 and TISA 750 at 0° and 180° = trabecular iris space area at 500 μm and 750 μm from the scleral spur at 0° and 180° angles

*Paired *t* test with preoperative data and 12-month postoperative data as test points

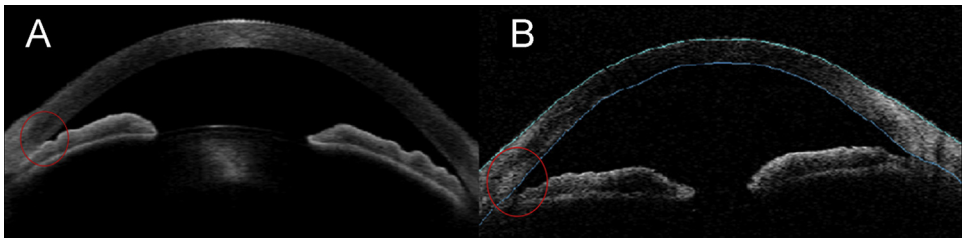

Figure 1. *A:* Anterior segment OCT images show the anterior chamber angle opening preoperatively. *B:* Anterior segment OCT images show the anterior chamber angle opening 12 months postoperatively. The red circle shows the widening of the anterior chamber angle postoperatively. The blue lines denote the anterior and posterior surfaces of the cornea.

stopped and the IOP was assessed at 1 day, 1 week, and 1, 3, 6, and 12 months. Then, ocular hypotensive medications were initiated only in patients whose postoperative IOP was more than 21 mm Hg. At 1 week, 6 eyes (13.6%) had an IOP over 21 mm Hg and a mean IOP of 25.1 ± 1.2 mm Hg. These cases were started on 1 ocular hypotensive medication. At 12 months, 38 eyes (86.4%) were off ocular hypotensive medications and the IOP in the 6 eyes mentioned above was controlled (<18 mm Hg) by 1 medication. Therefore, absolute success was achieved in 38 eyes (86.4%) and qualified success in 6 eyes (13.6%). There was a statistically significant reduction in the need for ocular hypotensive medications at 12 months ($P < .005$, χ^2 test). In the 38 cases in which no eyedrops were prescribed, the mean reduction in IOP at 12 months was 13.86 ± 1.84 mm Hg, whereas for the 6 patients taking ocular hypotensive medications, it was 15.33 ± 1.63 mm Hg.

DISCUSSION

The role of an anteriorly positioned thick lens in angle closure has been well established.[8–16] Recent studies[17–21] have shown that cataract extraction widens the iridocorneal angle and deepens the anterior chamber, both of which might be beneficial in eyes with PACG. However, these studies provide little information about the effect of lens extraction in eyes with primary angle closure. To our knowledge, the present study is the first to evaluate the effect of CLE on IOP and angle parameters in eyes with primary angle closure in a subset of patients with a higher risk for progressing to PACG.[3,25]

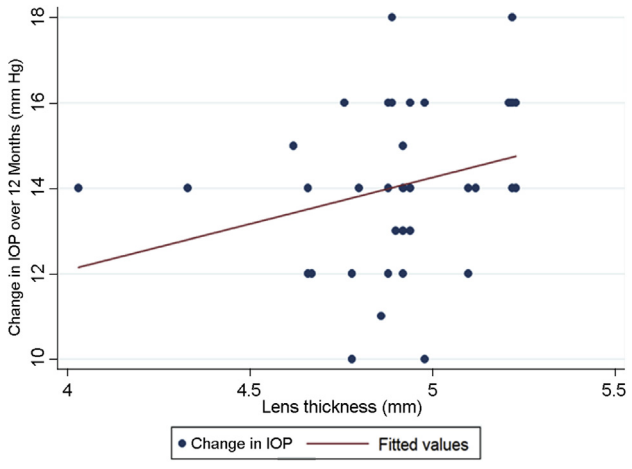

Figure 2. Correlation between change in IOP and lens thickness (IOP = intraocular pressure).

The present study showed a significant reduction in IOP after phacoemulsification and a significant reduction in the need for ocular hypotensive medications 12 months postoperatively (both $P < .005$). A retrospective study of 55 eyes with primary angle closure or PACG and visually significant cataract in which phacoemulsification was performed[9] found a statistically significant reduction in IOP over a mean follow-up of 7.2 months ($P = .0001$), with the reduction in IOP being notably greater than in eyes with a higher preoperative IOP. In that study, the median IOP reduction in all eyes was 3.0 mm Hg (range 5 to −19 mm Hg). Forty eyes with a preoperative IOP of less than 21 mm Hg had a mean postoperative change in IOP of –2.05 mm Hg, 11 eyes with preoperative IOP between 22 mm Hg and 30 mm Hg had a mean postoperative drop of 9.09 mm Hg, and 4 eyes with a mean preoperative IOP over 31 mm Hg had a mean postoperative IOP reduction of 17 mm Hg. The postoperative number of glaucoma medications in use decreased by 1 ($P = .01$).[9]

A retrospective study of 31 eyes with primary angle closure or PACG in which phacoemulsification was performed[24] showed a statistically significant reduction in IOP of 4.5 mm Hg after iridotomy ($P = .01$). A study of 74 eyes with PACG that had phacoemulsification reported a statistically significant reduction in IOP of 7.2 ± 3.5 mm Hg and in the number of medications (both $P < .0001$), with a mean follow-up of 25.7 ± 8.5 months.[19] In another study of the effect of phacoemulsification in 43 eyes with acute angle-closure glaucoma,[20] the mean preoperative IOP of 40.5 ± 7.6 mm Hg decreased to 17.8 ± 3.4 mm Hg over a mean follow-up of 10.2 ± 3.4 months.

Table 3. Univariate analysis correlations.

Parameter	*r* Value*	*P* Value
Preoperative ACD with		
Lens thickness	−0.818	.00004
Lens vault	−0.318	.02
Angle opening distance†		
At 0° with lens thickness	−0.575	.00003
At 180° with lens thickness	−0.443	.00004
At 0° with lens vault	−0.375	.029
Preoperative IOP with		
Lens thickness	0.641	.00004
Lens vault	0.372	.04
ACD	−0.623	.00004
Change in IOP over 12 months	0.662	.00002
Change in IOP with		
ACD	−0.609	.00003
Lens thickness	0.666	.00004
Lens vault	0.162	.32

ACD = anterior chamber depth; IOP = intraocular pressure
*Pearson correlation coefficient
†At points 500 µm from the scleral spur at the given angle

In the present study, the significantly greater reduction in IOP at 12 months could be because it included eyes with a higher preoperative IOP than in previous similar studies; thus, a greater drop in IOP might be expected. Another contributing factor might be that the eyes of patients taking ocular hypotensive medications postoperatively had a much lower IOP than the eyes in which no eyedrops were used.

In the present study, there was significant widening of the anterior chamber angle parameters and the ACD after CLE with the angle opening distance at 500 µm, increasing up to 3 times from the baseline values. Another study[24] also noted significant preoperative to postoperative improvements in the angle opening distance at 500 µm (from 0.09 ± 0.07 mm to 0.25 ± 0.09 mm; $P = .01$) and in the ACD (from 2.03 ± 0.30 mm to 3.39 ± 0.21 mm; $P < .01$).

One study[21] found that the iris diaphragm shifted backward by 850 µm and the anterior chamber angle initial value increased 50% at 3 months in eyes with senile cataract having phacoemulsification.

In our study, the mean lens thickness was 4.92 ± 0.231 mm (range 4.33 to 5.23 mm). We noted a statistically significant negative correlation between the lens thickness with the ACD and between the lens thickness and the angle opening distance 500 µm from scleral spur at the 0-degree angle. We also found a statistically significant positive correlation between the preoperative IOP and the change in IOP. Multivariate analysis showed the strongest determinant of change in IOP to be the preoperative IOP, followed by the preoperative ACD. This is an important finding that can guide surgeons in planning for lens extraction procedures in eyes with primary angle closure.

There could be merit in proceeding with lens extraction without performing an LPI in eyes with primary angle closure. At present, this is not the standard of care. A multicenter trial is in progress[27] to evaluate the effectiveness of early lens extraction in primary angle closure; the results in that study are forthcoming. Table 5 compares the parameters and outcomes in the present study with those in similar studies of primary angle closure and PACG.

The current protocol for treating primary angle closure with in eyes with a clear lens is to perform an LPI first and then to start ocular hypotensive medications if the IOP is not controlled after the LPI. Ocular hypotensive medications are usually required for a long time, and medical therapy might have to be escalated as the disease progresses despite the LPI. In cases of progression or when the IOP is not controlled medically, trabeculectomy is usually performed. However, trabeculectomy in angle closure is associated with a

Table 4. Multivariate analysis of the effect of parameters on the change in IOP.

	Unadjusted		Adjusted*	
Parameter	β (95% CI)	*P* Value	β (95% CI)	*P* Value
Age (y)	−0.05 (−0.11, 0.01)	.111	0.38 (−0.024, 0.101)	.220
Sex	−0.11 (−0.74, 0.52)	.726	−0.12 (−0.561, 0.314)	.571
ACD (mm)	2.25 (−2.5, 7.0)	.345	6.14 (2.51, 9.77)	.002
Lens thickness (mm)	2.17 (−0.21, 4.56)	.073	1.47 (−0.79, 3.75)	.196
Lens vault (mm)	−7.30 (−13.1, −1.43)	.016	−1.65 (−6.63, 3.32)	.504
Preop IOP (mm Hg)	0.92 (0.65, 1.18)	.0001	1.01 (0.74, 1.28)	.0001
Preop angle opening distance 500 at 0 degrees (mm)	−1.82 (−44.9, 41.3)	.932	21.61 (−11.41, 54.64)	.193

β = regression coefficient; ACD = anterior chamber depth; CI = confidence interval; IOP = intraocular pressure
*$R^2 = 0.69$; $P = .001$

Table 5. Comparison of the present study with previous studies.

Parameter	Study*						
	Present	Shams[9]	Nonaka[24]	Zhi[17]	Pereira[21]	Hayashi[19]	Jacobi[20]
Study type	Prospective	Retrospective	Retrospective	—	Prospective	Prospective	Prospective
Condition studied	PAC	PAC	PACS/PAC	PACG	Senile cataract	PACG	Acute ACG
Eyes (n)	44	55	13	—	21	74	43
IOP (mm Hg)							
Preop	27.1 ± 1.55	18.7 ± 7.3	18.2 ± 4.1	22.8	—	Significant drop	40.5 ± 7.6
Postop	13.2 ± 1.12	14.1 ± 4.0	14.3 ± 2.7	13.2	—	Significant drop	—
P value	.0001	—	<.01	.002	—	<.001	—
AOD 500 (mm)							
Preop	0.104 ± 0.015	—	0.09 ± 0.07	—	0.284	—	—
Postop	0.31 ± 0.013	—	0.25 ± 0.09	—	0.430	—	—
P value	.0003	—	<.01	—	<.001	—	—
ACD							
Preop	2.40 ± 0.019	—	2.03 ± 0.30	—	—	1.89 ± 0.33	—
Postop	3.17 ± 0.027	—	3.39 ± 0.21	—	—	3.94 ± 0.26	—
P value	.0002	—	<.01	—	—	—	—
Mean lens thickness	4.92 ± 0.231	—	—	—	—	—	—
Postoperative follow-up	12 mo	7.2 mo	3 mo	7 days	90 d	25.7 ± 8.5 mo	10.2 ± 3.4 mo

ACD = anterior chamber depth; ACG = angle-closure glaucoma; AOD = angle opening distance; IOP = intraocular pressure; PAC = primary angle closure; PACG = primary angle-closure glaucoma; PACS = primary angle closure suspect
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high risk for complications.[28] In addition, when medical therapy is underway after LPI in primary angle closure, there is an issue of poor compliance, which might lead to progression to irreversible optic neuropathy and the cost of a long-term medical therapy for the patient and the healthcare system.[29]

Lens extraction in primary angle closure cases works 3 ways. First, it controls the persistently raised IOP in eyes that have an increased IOP despite a patent LPI. Second, it widens the angle considerably and so might slow the disease progression to the stage of irreversible optic neuropathy. Third, it reduces or removes the need for ocular hypotensive medications, improving the patients' quality of life and reducing their economic burden of long-term pharmaceutical treatment.

The risks associated with a CLE in eyes with primary angle closure must be kept in mind. One is an early onset of presbyopia with a need for reading correction postoperatively. We used monofocal IOLs as per our study protocol; however, multifocal IOLs might have provided a better functional outcome in our patients, although there are issues of decreased contrast sensitivity with these IOLs.[30] The patients in the present study were older than 50 years, so most were already presbyopic. Other possible risks could be surgery related considering the difficulties in performing an early lens extraction in primary angle closure cases with shallow anterior chambers. These risks are greatly outweighed by the potential benefits when the surgery is performed by an experienced surgeon and the postoperative need for reading glasses is explained to the patient.

Limitations of our study include the need for a longer follow-up to be able to comment on maintenance of the IOP beyond 12 months, the possibility of progression to PACG, and the lack of a control group of eyes in which IOP was controlled using medications alone or with a trabeculectomy. Also, gonioscopic analysis for evaluation of the extent of synechia closure preoperatively and postoperatively is warranted. Hence, further studies are required to correlate the requirement of ocular hypotensive medications postoperatively and the extent of synechia angle closure in clock hours.

We emphasize that our modality of management does not in any way replace the existing conventional regimen being followed in cases of primary angle closure. An early lens extraction may only be considered if conventional treatment (LPI, iridoplasty, and medications) cannot control the IOP. Because these cases have no lens opacities and perfect vision, the general ophthalmic community should approach this procedure with caution and lens extraction should be performed by an expert. More precisely, this study recommends early lens extraction performed by an experienced surgeon only in eyes with primary angle closure that have a preoperative IOP that is raised more than 25 mm Hg for at least 8 weeks despite a patent LPI and ocular hypotensive medications.

In conclusion, CLE significantly reduced the IOP, caused angle widening, and reduced the requirement for ocular hypotensive medications in eyes with primary angle closure and persistently raised IOP after LPI.

WHAT WAS KNOWN

- Cataract surgery and CLE can lower IOP and widen the anterior chamber angle in patients with chronic angle closure glaucoma and an acute attack of angle closure.

WHAT THIS PAPER ADDS

- Clear lens extraction had significant therapeutic benefit in eyes with primary angle closure and ocular hypertension because it reduced IOP without an adjunctive need for medical therapy in most eyes.

REFERENCES

1. Foster PJ, Buhrmann R, Quigley HA, Johnson GJ. The definition and classification of glaucoma in prevalence surveys. Br J Ophthalmol 2002; 86:238–242. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1771026/pdf/bjo08600238.pdf. Accessed March 31, 2015
2. Thomas R, George R, Parikh R, Muliyil J, Jacob A. Five year risk of progression of primary angle closure suspects to primary angle closure: a population based study. Br J Ophthalmol 2003; 87:450–454. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1771602/pdf/bjo08700450.pdf. Accessed March 31, 2015
3. Sihota R, Rao A, Gupta V, Srinivasan G, Sharma A. Progression in primary angle closure eyes. J Glaucoma 2010; 19:632–636
4. Sihota R, Agarwal HC. Profile of the subtypes of angle closure glaucoma in a tertiary hospital in North India. Indian J Ophthalmol 1998; 46:25–29. Available at: http://www.ijo.in/text.asp?1998/46/1/25/14981. Accessed March 31, 2015
5. Das J, Bhomaj S, Chaudhuri Z, Sharma P, Negi A, Dasgupta A. Profile of glaucoma in a major eye hospital in North India. Indian J Ophthalmol 2001; 49:25–30. Available at: http://www.ijo.in/text.asp?2001/49/1/25/22660. Accessed March 31, 2015
6. Dandona L, Dandona R, Mandal P, Srinivas M, John RK, McCarty CA, Rao GN. Angle-closure glaucoma in an urban population in southern India; the Andhra Pradesh Eye Disease Study. Ophthalmology 2000; 107:1710–1716
7. Vijaya L, George R, Arvind H, Baskaran M, Paul PG, Ramesh SV, Raju P, Kumaramanickavel G, McCarty C. Prevalence of angle-closure disease in a rural southern Indian population. Arch Ophthalmol 2006; 124:403–409
8. Mei L, Zhonghao W, Zhen M, Yimin Z, Xing L. Lens thickness and position of primary angle closure measured by anterior segment optical coherence tomography. J Clin Exp Ophthalmol 2013; 4:281. Available at: http://omicsonline.org/measured-by-anterior-segment-optical-coherence-tomography-2155-9570.1000281.pdf. Accessed March 31, 2015
9. Shams PN, Foster PJ. Clinical outcomes after lens extraction for visually significant cataract in eyes with primary angle closure. J Glaucoma 2012; 21:545–550
10. Musch DC, Gillespie BW, Niziol LM, Janz NK, Wren PA, Rockwood EJ, Lichter PR; Collaborative Initial Glaucoma Treatment Study (CIGTS) Group. Cataract extraction in the collaborative initial glaucoma treatment study; incidence, risk factors, and the effect of cataract progression and extraction on clinical and quality-of-life outcomes. Arch Ophthalmol 2006; 124:1694–1700. Available at: http://archopht.jamanetwork.com/data/Journals/OPHTH/9977/ecs60052_1694_1700.pdf. Accessed March 31, 2015
11. Lowe RF. Aetiology of the anatomical basis for primary angle-closure glaucoma; biometrical comparisons between normal eyes and eyes with primary angle-closure glaucoma. Br J Ophthalmol 1970; 54:161–169. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1207665/pdf/brjopthal00315-0017.pdf. Accessed March 31, 2015
12. Sihota R, Lakshimaiah NC, Agarwal HC, Pandey RM, Titiyal JS. Ocular parameters in the subgroups of angle closure glaucoma. Clin Exp Ophthalmol 2000; 28:253–258
13. Sihota R, Dada T, Gupta R, Lakshminarayan P, Pandey RM. Ultrasound biomicroscopy in the subtypes of primary angle closure glaucoma. J Glaucoma 2005; 14:387–391
14. Wang D, Pekmezci M, Basham RP, He M, Seider MI, Lin SC. Comparison of different modes in optical coherence tomography and ultrasound biomicroscopy in anterior chamber angle assessment. J Glaucoma 2009; 18:472–478
15. Silver DM, Quigley HA. Aqueous flow through the iris-lens channel: estimates of differential pressure between the anterior and posterior chambers. J Glaucoma 2004; 13:100–107
16. Pavlin CJ, Ritch R, Foster FS. Ultrasound biomicroscopy in plateau iris syndrome. Am J Ophthalmol 1992; 113:390–395
17. Zhi ZM, Lim ASM, Wong TY. A pilot study of lens extraction in the management of acute primary angle-closure glaucoma. Am J Ophthalmol 2003; 135:534–536
18. Tarongoy P, Ho CL, Walton DS. Angle-closure glaucoma: the role of the lens in the pathogenesis, prevention, and treatment. Surv Ophthalmol 2009; 54:211–225
19. Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. J Cataract Refract Surg 2001; 27:1779–1786
20. Jacobi PC, Dietlein TS, Lüke C, Engels B, Krieglstein CK. Primary phacoemulsification and intraocular lens implantation for acute angle-closure glaucoma. Ophthalmology 2002; 109:1597–1603
21. Pereira FAS, Cronemberger S. Ultrasound biomicroscopic study of anterior segment changes after phacoemulsification and foldable intraocular lens implantation. Ophthalmology 2003; 110:1799–1806
22. Ang LPK, Aung T, Chew PTK. Acute primary angle closure in an Asian population: long-term outcome of the fellow eye after prophylactic laser peripheral iridotomy. Ophthalmology 2000; 107:2092–2096
23. Nolan WP, Foster PJ, Devereux JG, Uranchimeg D, Johnson GJ, Baasanhu J. YAG laser iridotomy treatment for primary angle closure in east Asian eyes. Br J Ophthalmol 2000; 84:1255–1259. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1723285/pdf/v084p01255.pdf. Accessed March 31, 2015
24. Nonaka A, Kondo T, Kikuchi M, Yamashiro K, Fujihara M, Iwawaki T, Yamamoto K, Kurimoto Y. Cataract surgery for residual angle closure after peripheral laser iridotomy. Ophthalmology 2005; 112:974–979
25. Chen Y-Y, Sun L-P, Thomas R, Liang Y-B, Fan S-J, Sun X, Li S-Z. Long-term intraocular pressure fluctuation of primary angle closure disease following laser peripheral iridotomy/iridoplasty. Chin Med J 2011; 124:3066–3069. Available at: http://www.ecmj.org.cn/ch/reader/create_pdf.aspx?file_no=201192957720480&year_id=2011&quarter_id=19&falg=1. Accessed March 31, 2015

26. Thomas R, Walland MJ, Parikh RS. Clear lens extraction in angle closure glaucoma. Curr Opin Ophthalmol 2011; 22:110–114
27. Azuara-Blanco A, Burr JM, Cochran C, Ramsay C, Vale L, Foster P, Friedman D, Quayyum Z, Lai J, Nolan W, Aung T, Chew P, McPherson G, McDonald A, Norrie J; Effectiveness in Angle-closure Glaucoma of Lens Extraction (EAGLE) Study Group. The effectiveness of early lens extraction with intraocular lens implantation for the treatment of primary angle-closure glaucoma (EAGLE): study protocol for a randomized controlled trial. Trials 2011; 12:133. Available at: http://www.trialsjournal.com/content/pdf/1745-6215-12-133.pdf. Accessed March 31, 2015
28. Tham CCY, Kwong YYY, Baig N, Leung DYL, Li FCH, Lam DSC. Phacoemulsification versus trabeculectomy in medically uncontrolled chronic angle-closure glaucoma without cataract. Ophthalmology 2013; 120:62–67
29. Quek DTL, Ong G-T, Perera SA, Lamoureux EL, Aung T. Persistence of patients receiving topical glaucoma monotherapy in an Asian population. Arch Ophthalmol 2011; 129:643–648. Available at: http://archopht.jamanetwork.com/article.aspx?articleid=427340. Accessed March 31, 2015
30. Law SK, Riddle J. Management of cataracts in patients with glaucoma. Int Ophthalmol Clin 2011; 51(3):1–18

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