

CLINICAL ASSESSMENT OF VISUAL ACUITY, REFRACTIVE CHANGES AND IOP FOLLOWING ND:YAG LASER CAPSULOTOMY FOR POSTERIOR CAPSULAR OPACIFICATION

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ABSTRACT

BACKGROUND

Nd:YAG laser capsulotomy remains standard treatment of PCO. Various studies have given differing results on BCVA, refraction and changes in IOP following Nd:YAG capsulotomy. Our study will attempt to assess these parameters and decide over any management changes required before and after Nd:YAG laser capsulotomy.

The aim of the study is to assess the effect of Nd:YAG capsulotomy on BCVA, refraction (spherical equivalent) and IOP.

MATERIALS AND METHODS

BCVA, refraction, IOP measurement, slit lamp examination and fundoscopy was done 1 hour, 1 week, 4 weeks and 3 months after the Nd:YAG capsulotomy. This is a prospective observational study with sample size of 40 patients. Study design used was one-way ANOVA and Bivariate correlation. Study was analysed by SSPE software.

RESULTS

Our study enrolled 40 patients randomly. Improvement in BCVA was significant for all our follow ups with p value 0.00 for all visits. Change in SE was not significant in any of our follow up (p 0.22 for 1st hour, 0.19 for 1st week; 0.25 for 4th week, 0.13 for 3rd month). Change in IOP was significant in 1st hour with a rise in IOP of 2.23±2.51 mm hg (p 0.00). There was no significant change in IOP with subsequent visits (p 0.38 for 1st week, 0.13 for 4th week, 0.15 for 3rd month) There was no linear correlation between power used and IOP changes.

CONCLUSION

Nd:YAG capsulotomy is very effective procedure in restoring visual acuity of patients with posterior capsular opacification. Routine IOP lowering topical drugs can be used prior to the procedure to prevent IOP rise immediately following procedure.

KEYWORDS

Posterior Capsular Opacification (PCO), Nd:YAG Laser Capsulotomy, Best Corrected Visual Acuity (BCVA), Spherical Equivalent (SE), Intraocular Pressure (IOP), Intraocular Lens (IOL).

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BACKGROUND

Cataract is defined as any opacity that develops in the crystalline lens that impairs vision. It is the most common cause of curable blindness and lower vision.

Posterior Capsular Opacity (PCO, secondary cataract, after cataract) is the most common complication of ECCE, SICS or phacoemulsification.¹

PCO is the most common long-term complication of cataract surgery. It causes decreased vision, glare, monocular diplopia. Rates of PCO have finally started coming down due to phacoemulsification technique of cataract surgery and sharp edge IOL use. Incidence of PCO is

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reported to be different in various studies. In one study it is reported to be 43%.²

Nd:YAG laser capsulotomy remains standard treatment of PCO.³ Most of the studies have shown rapid improvement in visual acuity, both corrected and uncorrected after Nd:YAG capsulotomy. Improvements in glare and contrast sensitivity may also be important outcome measures for many patients. There is a theoretical hyperopic shift after capsulotomy due to posterior movement of IOL. One study has shown subtle posterior shift in IOL⁴ where as others have failed to show this effect.⁵ Considering risk of posterior IOL shift, it has been suggested that Nd:YAG capsulotomy be performed before taking up any corneal laser procedure for residual refraction.

There are studies reporting increase in IOP following Nd:YAG laser capsulotomy.^{6,7} Peak increase usually occurs within 2-3 hours.

PCO represents a significant cost to the health care system. In the US, almost one million patients undergo Nd:YAG laser capsulotomy per year which costs up to \$250 million annually.

Dilemma of developing world is that even after successful IOL surgery patients may be lost to follow up for PCO development or even if they follow up, there will not be access to treatment modalities of PCO like Nd:YAG lasers.

There have been studies on various parameters before and after Nd:YAG capsulotomy with findings differing amongst studies. Our study is attempted to assess parameters like BCVA (best corrected visual acuity), refraction and IOP before and after Nd:YAG capsulotomy at our center and to know if there are any significant changes in parameters which might help us in planning any changes in management of PCO.

Aims and Objectives

- To assess the effect of Nd:YAG capsulotomy on best corrected visual acuity (BCVA) and refraction (spherical equivalent).
- To study the effect of Nd:YAG capsulotomy on intraocular pressure (IOP).

MATERIALS AND METHODS

Source of Data

Patients attending the Out-Patient Department during 18 months period from November 2014 to June 2016, who have undergone uncomplicated SICS/ Phacoemulsification with PCIOL implant, presenting with symptoms of decreased visual acuity, glare, mono-ocular diplopia and other symptoms similar to cataract itself and symptoms not occurring due to other ocular pathologies.

Methods of Data Collection

This is a prospective observational study with sample size of 40 patients fulfilling the inclusion criteria. Study design used was one-way ANOVA and Bivariate correlation. Study was analysed by SSPE software.

Inclusion Criteria

Age group 40-70 years Post-operative cases of uncomplicated SICS/ Phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation

Exclusion Criteria

- Shallow anterior chamber
- Pseudoexfoliation
- Uveitis
- Corneal pathology
- Intraoperative complications including PC rent, zonular dialysis
- Inherent zonular weakness
- Relative afferent pupillary defect (RAPD)
- Patients with anterior chamber intraocular lenses (ACIOL)
- High myopic and hypermetropic refractive errors greater than +6.0 or -6.0 diopters.

Study requires use of slit lamp, autorefraction, direct and indirect ophthalmoscope, non-contact tonometer (NCT), Nd:YAG laser instrument.

Duration of study will be 18 months.

Examination Technique

Patients presenting with complaints of diminution of vision, mono-ocular diplopia and glare were subjected to detailed ocular examination to confirm that visual loss is due to PCO only. Informed consent was obtained from each patient after explaining them the need for the study, duration, follow up requirements and other relevant details of the study in their vernacular language. Our study procedures were in accord with ethical standards on human experimentation. None of our patients were lost to follow up.

Examination Includes

- Detailed general history, medical history and ophthalmic history.
- Best corrected visual acuity (BCVA).
- Autorefraction
- IOP measurement.
- Slit lamp examination.
- Fundus examination (DO and IDO)

Nd:YAG Capsulotomy Procedure

Preparation of the Patient-

Patients were briefed about the purpose and nature of the procedure. Informed consent was taken.

Patients were explained that-

- The procedure is painless and will take few minutes.
- Small clicks or pops will be heard.
- Steady fixation needs to be maintained.

The patient is made to sit with properly adjusted stool, table, and chin rest heights and a footrest when required. Head strap was applied behind the patient's head whenever needed to counteract patient's tendency to move back during the treatment. Room was darkened for improved visualization of the target. If a patient was expected to fixate with the other eye, an illuminated fixation target was provided. Topical anaesthetic was applied if contact lens was used.

Visual axis and normal pupillary size determined, preliminary laser shot given. Focal point of the helium- neon aiming beam was brought into a clear focus. The minimal amount of energy necessary to breakdown and rupture the capsule was applied. Initial energy applied by using 1 to 2 mJ/pulse.

Series of laser punctures made in a cruciate pattern. Capsulotomy size kept as large as isotopic pupil. Residual tags and freely floating fragments removed.

No topical IOP reducing drops were applied before and immediately after Nd:YAG capsulotomy. Timolol 0.5% eye drops were used if there was spike in IOP 1 hour after the procedure and then in all patients twice a day was prescribed for 1 week to prevent late rise in IOP. Topical steroid (loteprednol) was given 3 to 4 times a day for a week and then tapered as required to prevent iritis.

BCVA, refraction, IOP measurement, slit lamp examination and fundoscopy was done 1 hour, 1 week, 4 weeks and 3 months after the procedure.

RESULTS

Our study enrolled 40 patients randomly with mean age of 63.10 years. Minimum age was 50 years and maximum was 78 years. Out of 40 patients, 19 were males and 21 were females. Mean male age was 61.36 years and mean female age was 58.85 years. All patients were operated for uncomplicated cataract surgery (SICS/Phacoemulsification) with posterior chamber IOL implant and had presented to Goa Medical college OPD with symptoms of PCO. Study was

undertaken for a period of 18 months, from November 2014 to May 2016 and all Nd:YAG capsulotomies were performed during this period at our hospital only.

Mean power used for Nd:YAG laser capsulotomy was 10.65 mJ. Patients were assessed for BCVA, spherical equivalent of refraction and IOP prior to Nd:YAG laser capsulotomy and then 1 hour, 1 week, 4 weeks and 3 months after the procedure.

Age	50	55	56	57	58	59	60	62	63	64	65	66	67	68	70	71	73	75	78
No. of Cases	1	4	2	2	1	1	8	2	3	1	2	2	1	1	3	1	1	3	1
Percent	2.5	10	5	5	2.5	2.5	20	5	7.5	2.5	5	5	2.5	2.5	7.5	2.5	2.5	7.5	2.5

Table 1. Age Distribution in Our Study

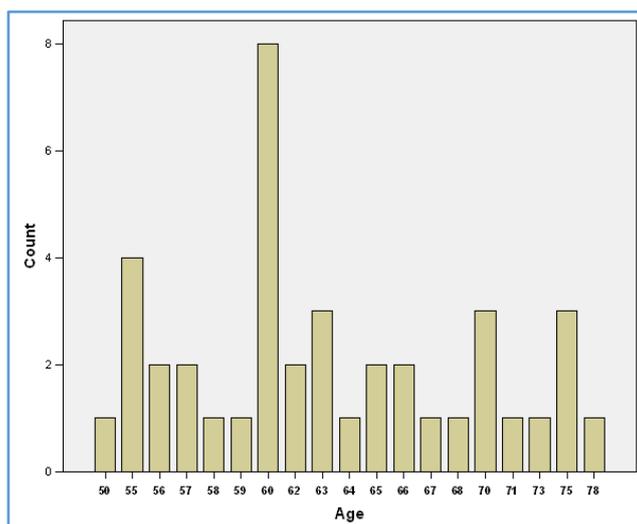


Figure 1. Age Distribution of PCO in Our Study

Sex	No.	Percent
Males	19	47.5
Females	21	52.5
Total	40	100

Table 2. Sex Distribution of PCO in Our Study

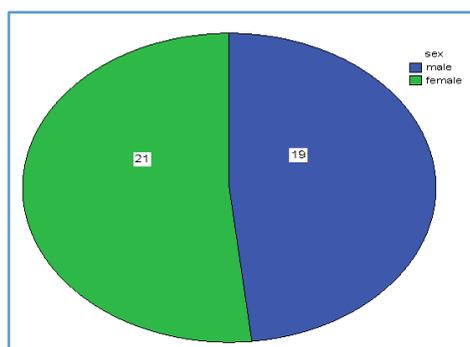


Figure 2. Sex Distribution of PCO in Our Study. Male to Female Ratio was 0.9:1

Sex	Mean age (years)
Male	61.36
Female	58.85

Table 3. Mean Age of Both Sexes

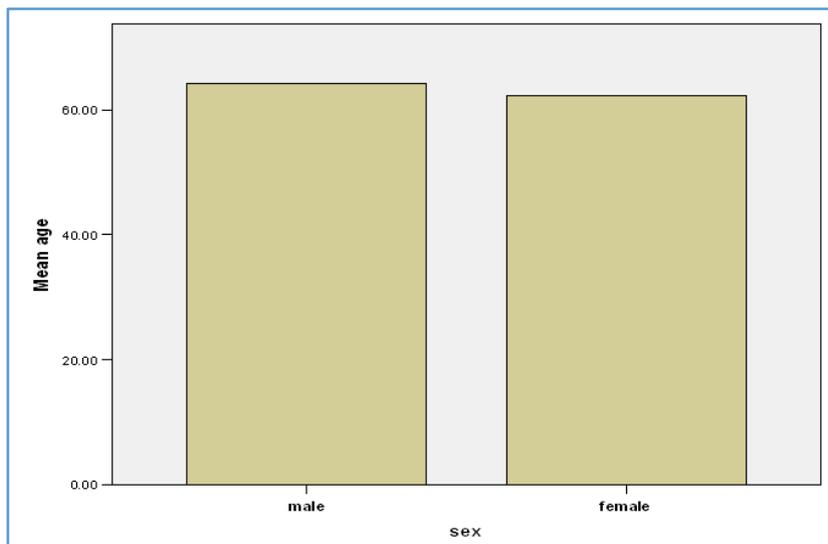


Figure 3. Mean Age Male and Female with PCO

BCVA	Pre-capsulotomy	1 st hour	1 st week	4 weeks	3 months
Mean	0.82 ± 0.34	0.36 ± 0.18	0.33 ± 0.17	0.31 ± 0.14	0.31 ± 0.14
p value	0.00	0.00	0.00	0.00	0.00

Table 4. Mean BCVA and p Values Before and After Nd:YAG Capsulotomy

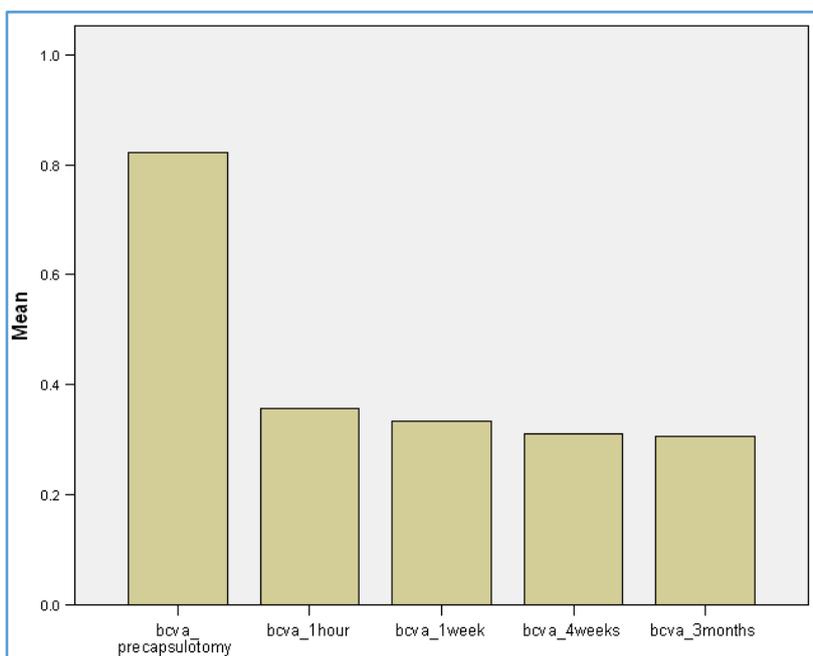


Figure 4. Mean BCVA Before and After Nd:YAG Capsulotomy

Improvement in BCVA was significant for all our follow ups with p value 0.00 for all visits.

SE	Pre-capsulotomy	1 st hour	1 st week	4 weeks	3 months
Mean	-0.88 ± 2.04	-0.65 ± 1.47	-0.64 ± 1.41	-0.67 ± 1.44	-0.57 ± 1.36.
p value	0.22	0.19	0.25	0.13	0.22

Table 5. Mean SE Before and After Nd:YAG Capsulotomy

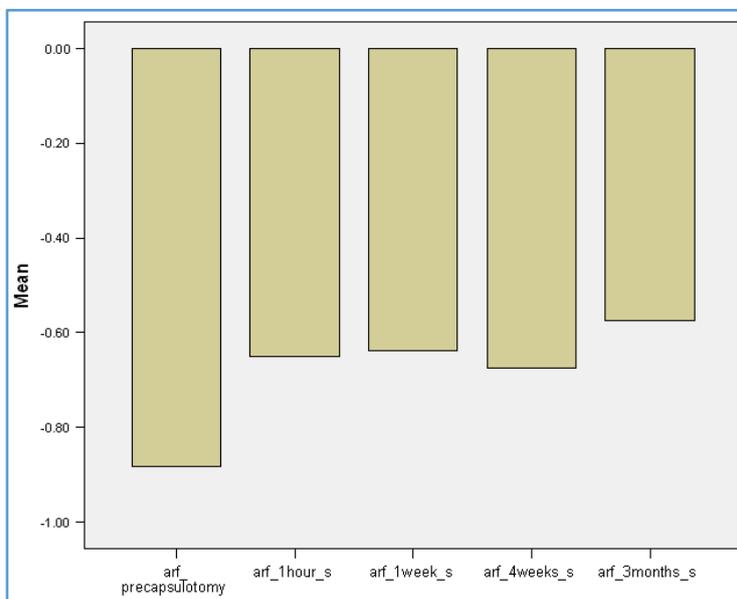


Figure 5. Mean SE Before and After Nd:YAG Capsulotomy

Change in SE was not significant in any of our follow up (p 0.22 for 1st hour, 0.19 for 1st week; 0.25 for 4th week, 0.13 for 3rd month).

IOP	Pre-Capsulotomy	1 st hour	1 st week	4 weeks	3 months
Mean	13.10 ± 2.99	15.32 ± 3.44	13.45 ± 3.85	12.68 ± 3.60	12.70 ± 3.07
p value	0.00	0.38	0.13	0.15	0.00

Table 6. Mean IOP Before and After Nd:YAG Capsulotomy

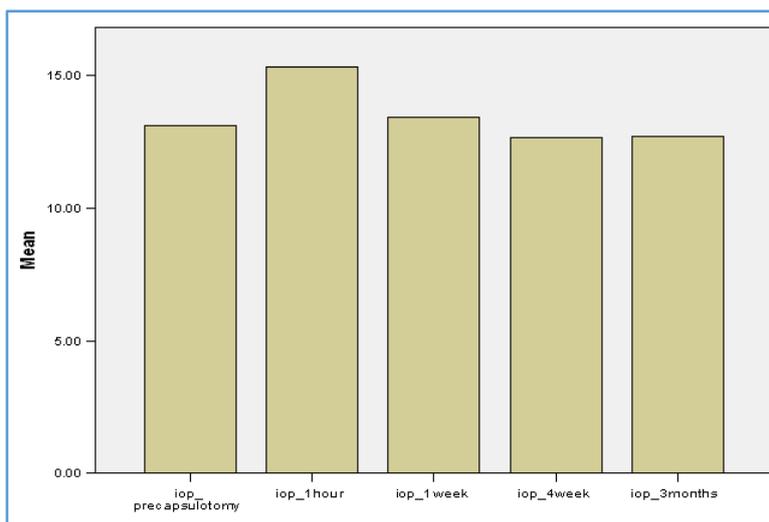


Figure 6. IOP Changes Before and After Nd:YAG Capsulotomy

Change in IOP was significant in 1st hour with a rise in IOP of 2.23± 2.51 mm hg (p 0.00). There was no significant change in IOP with subsequent visits (p 0.38 for 1st week, 0.13 for 4th week, 0.15 for 3rd month)

Changes in IOP	Pearson Correlation (r)	Significance (p Value)
1 hour	0.078	0.63
1 week	0.329	0.038
4 weeks	0.272	0.09
3 months	0.299	0.061

Table 7. Bivariate Correlation Between Power used for Capsulotomy and IOP Changes

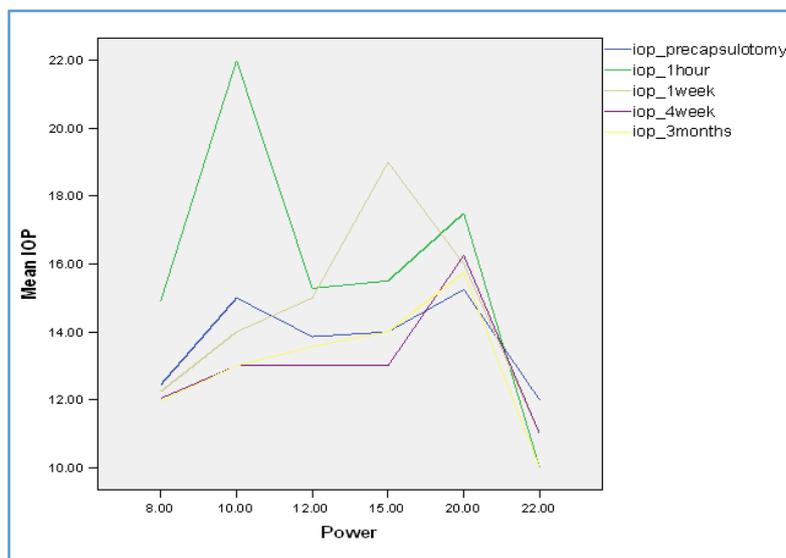


Figure 7. Correlation between Changes in IOP with Power used for Capsulotomy

Pearson's correlation coefficient (r) between power used for capsulotomy and changes in IOP at follow up and P value for significance of correlation shows that there is no linear correlation between power used and IOP changes except in 1st week of follow up which shows positive correlation between power used and IOP changes.

DISCUSSION

In our study BCVA, SE and IOP were assessed before Nd:YAG capsulotomy and then 1 hour, 1 week, 4 weeks and 3 months after the procedure. Though our study had more number of female patients, literature review did not mention any possible cause for predominance of PCO in either sex. Male to female ratio was 0.9:1 in our study.

Studies on changes in visual acuity after Nd:YAG capsulotomies have shown that there is significant improvement in BCVA after the procedure.⁸ Our study also has shown rapid and significant improvement in BCVA after Nd:YAG capsulotomy ($p < 0.00$). None of our patients showed deterioration in visual acuity in follow up visits. This improvement must be because of clearer visual axis created by Nd:YAG capsulotomy. Nd:YAG capsulotomy has been accepted as standard treatment technique for PCO⁹ resulting in rapid improvement in visual acuity and BCVA and our study also found it so.^{10,11} A NPCB study reported 2.7% reduction in visual acuity post Nd:YAG capsulotomy when candidates were not selected properly. Otherwise none of the studies showed decrease in vision without a definite cause following Nd:YAG laser capsulotomy.

Various studies have been done on changes in spherical equivalent (SE) of refraction after Nd:YAG capsulotomy. Procedure creates a clear visual axis which should improve refraction. Most of the studies have not shown significant changes in SE after Nd:YAG capsulotomy.¹² Our study also did not find any significant changes in SE in any of our follow up visits as seen in table 7. There are many studies which have reported hyperopic shift in SE following the procedure. This was attributed to posterior shift of IOL following capsulotomy. But there are studies that have failed to

observe such shift.¹³ With posterior shift in IOL, anterior chamber depth is expected to increase. Studies have not found significance of such findings in anterior chamber.¹⁴

This suggests that there is no need for refraction following Nd:YAG capsulotomy to ensure optimal visual outcome.

Studies done on IOP changes following Nd:YAG capsulotomy have shown spike in IOP within hours of the procedure. Rise is seen to peak at 2-3 hours, remains elevated for 24 hours and comes to normal level after 1 week. In our study, there was significant rise in IOP within an hour of Nd:YAG capsulotomy ($p < 0.00$). There was no significant change in IOP in later follow up visits. Only 4 patients had rise of 21 mm hg or above after 1 hour of the procedure. All patients with rise in IOP were successfully treated with anti-glaucoma medications. None of our patients had IOP of 21 or above on 1st week follow up. Only 1 patient had 21 mm hg IOP on 4th week follow up. None of the patients were having 21 mm hg or above on last follow up. In our study there was no linear correlation between power used for capsulotomy and IOP changes after 1 hour, 4 weeks and 3 months. There was significant positive correlation between power used and IOP changes 1 week after the procedure.

Increase in IOP of 15-30% following capsulotomy was noted by various studies.

One study has reported IOP rise in 0-6% of patients following the procedure.¹⁵ Another study has reported 1% rise in IOP after the procedure.¹⁶ Ge et al. found that rise in IOP within an hour of Nd:YAG capsulotomy was more pronounced in patients with glaucoma.¹⁷ Shani et al. did not find IOP rise in normal pseudophakic eyes.¹⁸ Ari et al. also did not find persistent IOP rise after the procedure.¹⁹

Such differences in studies related to changes in IOP following Nd:YAG capsulotomy could be due to different capsulotomy sizes or energy used to open the capsule. Studies have also shown that there was no relationship between IOP rise and energy per pulse or total energy as seen in our study.²⁰

There are long term follow up studies on patients who had rise in IOP 1 hour after Nd:YAG capsulotomy. It is found that long term IOP increase is significantly associated with IOP rise 1 hour after the procedure and those who had glaucoma. In our study, patients with glaucoma were excluded and it was a short-term study. So our study could not check such association. No Nd:YAG related complications were reported in our study during our follow up visits.

Our study has limitations. The sample was small and represents results at the Goa Medical College only. Our results were based on follow up of just 18 months which was short. More studies are needed like examination of IOL movement after Nd:YAG laser capsulotomy with a B-scan to assess differences in SE after the procedure. Studies on the effect of capsulotomy size on various parameters assessed in our study are needed.

CONCLUSION

Nd:YAG capsulotomy is very effective and safe procedure in restoring visual acuity of patients with posterior capsular opacification. It carries minimal risk of complications.

Our study suggests that there is no need for routine refraction following Nd:YAG laser capsulotomy following PCO in an uncomplicated cataract surgery.

Routine IOP lowering topical drugs can be used prior to the procedure to prevent IOP rise immediately following procedure. Power of Nd:YAG laser for capsulotomy can be increased further for denser PCO as risk of IOP rise with increase in power did not correlate.

Further studies on IOL movement following Nd:YAG capsulotomy using ultrasound biomicroscopy will be needed. Further studies on capsulotomy size affecting various parameters will be needed. Long term follow-up of patients for persistent IOP rise who had IOP rise in an hour of the procedure will be needed to see if these are the patients who need individualised management. Further such studies to include established glaucoma patients who have undergone capsulotomy may also be needed to assess the variations in IOPs compared to non-glaucomatous patients.

Management of patients with PCO needs to be individualised.

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