

# Immediate Changes Of Diurnal Variation in Intraocular Pressure after Laser Peripheral Iridotomy In Primary Angle Closure Glaucoma Patients

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## Abstract

**AIM:** To determine the immediate changes of diurnal variation in intraocular pressure (IOP) after Laser Peripheral Iridotomy in primary angle closure glaucoma patients.

## METHODOLOGY:

Prospective study conducted on 128 eyes of 64 patients of whom PI was done. IOP was measured every 3 hourly for 24 hours and diurnal variation was noted. Angle of anterior chamber measured by Shaffer's method using gonioscope pre-PI. Anterior segment OCT and slit lamp examination done after 24 hours of PI to check the patency of PI.

## RESULTS:

Average IOP immediately after PI in treated eyes was  $22.4 \pm 4.5$  mmHg and  $15.9 \pm 2.6$  mmHg in fellow eyes. The IOP of treated eyes were higher than those of fellow eyes at every time point, showing parallel properties without any significant differences in IOP fluctuation. On OCT and slit-lamp PI was found to be patent in all the patients after 24 hours of procedure.

## CONCLUSION:

Eyes in which more laser energy and a higher number of laser pulses were used, with shallower central anterior chamber were at increased risk of increased IOP. The diurnal IOP curves showed relatively parallel properties between both the eyes, with trough IOP in the morning hours and peak IOP in midnight hours.

**KEYWORDS:** PI (Peripheral iridotomy), PACG (Primary Angle Closure Glaucoma), OCT (Optical Coherence Tomography), IOP (Intra Ocular Pressure)

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## I. Introduction:

Although primary open-angle glaucoma (POAG) is the most common form of glaucoma, but the risk of blindness is more in PACG if inappropriately treated. Early detection of PACG and its appropriate management presents a challenging task, especially in the developing countries.

PI has been a well established method in treating PACG by eliminating pupillary block and widening the angles by reducing the pressure differential between the anterior and posterior chambers. Standard glaucoma medications can be added if intraocular pressure (IOP) remains high despite LI.

## Classification of Primary Angle Closure

Type of PAC	Characteristics
PACS	$\geq 180^\circ$ of ITC, normal IOP, no PAS, and no optic neuropathy
PAC	$\geq 180^\circ$ of ITC with PAS or elevated IOP, but no optic neuropathy
PACG	$\geq 180^\circ$ of ITC with PAS, elevated IOP, and optic neuropathy
APAC or AACC	Occluded angle with symptomatic high IOP

AACC = acute angle-closure crisis; APAC = acute primary-angle closure; IOP = intraocular pressure; ITC = iridotrabecular contact (defined as nonvisibility of posterior trabecular meshwork on static gonioscopy); PAC = primary angle closure; PACG = primary angle-closure glaucoma; PACS = primary angle-closure suspect; PAS = peripheral anterior synechiae.

LPI may be performed using an argon laser or an Nd: YAG laser. Diode laser has also been used. Nd: YAG is the most commonly used type of laser for LPI. The LPI closure rate is lower when Nd: YAG is used. Disruption of the iris pigment epithelium may occur with this type of laser. Pigment migration and plugging accounts for most cases of LPI closures, except in uveitis, where fibrin may close the LPI.

PI, although a minor procedure, is not free from complications. It's late complications can be drop in vision, accelerated development of cataract and development of posterior synechiae.

IOP has been proven to have a definite circadian rhythm, and its fluctuation, both short term and long term, have been indicative of glaucoma progression. In fact, both peak intraocular pressure and IOP fluctuations are known independent risk factors for disease progression. Large diurnal intraocular pressure fluctuations may be considered as an independent risk factor for the disease. To better understand the physiology of IOP variations in angle closure patients, one additional diurnal IOP recording is necessary following laser peripheral iridotomy.

In our study every 3 hourly we recorded IOP post YAG PI for 24 hours to assess the mean intraocular pressure, diurnal fluctuations in IOP of treated eyes and compared it with the fellow eye.

## **II. Material And Methods**

This is a prospective, interventional study, conducted after taking an informed consent from patients who were admitted in Department of Ophthalmology, J.L.N. Medical College and Associated Hospitals, Ajmer (Raj.) from October 2018 to March 2020. Ethical clearance was obtained from institutional review board.

Inclusion criteria

1. Age between 20 to 70 yrs
2. Cooperative patient

Exclusion criteria

1. Patient who has underwent any type of intraocular surgery.
2. Subjects in whom LPI was found absent,
3. Age < 20 years.
4. History of any previous corneal surgery including refractive surgery, scarred or hazy corneas, microphthalmos, blepharospasm, nystagmus, keratoconus, any current conjunctival or corneal infection, any other ocular disease or any systemic disease

### **Plan of study:**

128 eyes of 64 patients were selected on the basis of inclusion and exclusion criteria. All the patients included in the study were examined by the same operator and same observer to eliminate observer's bias. Informed written consent was taken at the time of examination.

All patients fulfilling the inclusion criteria underwent detailed ocular examination including comprehensive history, recording of visual acuity, slit lamp, intraocular pressure, fundus examination, ocular and systemic investigation, as per performa.

Patients of Primary Angle Closure Glaucoma underwent ND: YAG Laser Peripheral iridotomy, and IOP monitoring was done till next 24 hrs after every 3 hour interval to record the diurnal variation in the treated eyes and fellow eyes followed by slit lamp examination and ASOCT to check the patency of iridotomy.

### **PROCEDURE OF ND: YAG LASER IRIDOTOMY:**

After full explanation to a patient of what the procedure involves, what to expect (e.g., seeing a flash, hearing and feeling a "pop," electric shock sensation), and after informed consent obtained from a patient, pilocarpine 2% drops were instilled every 5 minutes three times in the procedure eye. Adequate constriction and akinesia of the pupil was ensured. Proparacaine was instilled for anesthesia.

Laser energy selected was between 4 mJ and 6 mJ and single pulse mode preferred. Generally, one to 10 single pulses were sufficient. The less energy used to perforate the iris, the better it is. A corneal contact lens with a plano-convex button (Abraham or Wise lens) was placed on the corneal surface of concerned eye after filling it with a coupling agent.

The laser beam was focused on the iris along the superior peripheral iris, usually at 11 o'clock or 1 o'clock position, where it can be covered by the upper eyelid. Furthermore, location is influenced by the presence of iris crypts along the superior peripheral iris, in which the iris is already thinned and penetration may be easier.

Laser energy was delivered until full thickness perforation was achieved. A "gush" of fluid and pigment may be seen once this is achieved. This represents aqueous passage from a higher pressure posterior chamber to a lower pressure anterior chamber, thus breaking the pupillary block. The iris should fall back away from the angle to a flat position because the pressures in the anterior and posterior chambers are now equalized.

The contact lens then removed; the patient was reassured and asked to wait for 24 hours for an IOP check. In the absence of complications, the patient was instructed to use prednisolone acetate 1% drops four

times a day for 4 days in the operated eye after 24hours. Pre-laser medications were continued except for miotics (to avoid synechiae formation).

The number of laser pulses and the total energy used was recorded. Pre and post 1hour after PI IOP were noted. Then diurnal variation was noted after every 3 hours using Applanation tonometer. Peak of IOP fluctuation was also noted. Patency of the iris checked using anterior chamber OCT and slit lamp. Anti-glaucoma medications were not used while measuring diurnal variation.

### III. Observation And Results

Among the 64 PRIMARY angle closure glaucoma patients included in this study 41 were females and 23 were males i.e. 64.1 % were females and 35.9% males. Both the groups were comparable ( $p < 0.05$ )

Among the 64 pateints LPI was done in RE in 32 and in LE in 32 which was found to be non- significant statistically.

Most of the study participants i.e 24 patients were in age group of 50- 60 years, followed by 18 patients of 40- 50 years of age.

Mean intra-ocular pressure in PACG patients before iridotomy is  $34.3 \pm 5.1$  mmHg in treated eyes and  $15.7 \pm 3.1$ mmHg in fellow eyes which was found significant ( $p < 0.05$ ).

#### Mean intra-ocular pressure recorded for 24 hrs post-operatively

Mean IOP (mm Hg)	Treated Eye n=64 (Mean $\pm$ SD)	Fellow Eye n=64 (Mean $\pm$ SD)	p value (Unpaired 't' test)
Before surgery	34.3 $\pm$ 5.1	15.7 $\pm$ 3.1	0.000
After 1 hr	22.4 $\pm$ 4.5	15.9 $\pm$ 2.6	0.000
After 3hrs	18.2 $\pm$ 2.6	14.4 $\pm$ 1.9	0.000
After 6hrs	16.9 $\pm$ 2.3	14.2 $\pm$ 2.2	0.000
After 9hrs	19.1 $\pm$ 3.0	15.2 $\pm$ 2.9	0.000
After 12hrs	17.6 $\pm$ 2.3	14.2 $\pm$ 2.0	0.000
After 15hrs	17.7 $\pm$ 2.0	14.1 $\pm$ 2.0	0.000
After 18hrs	19.0 $\pm$ 2.3	14.9 $\pm$ 2.4	0.000
After 21 hrs	20.3 $\pm$ 2.6	14.5 $\pm$ 2.4	0.000
After 24hrs	16.7 $\pm$ 2.7	13.4 $\pm$ 2.2	0.000

#### Mean intra-ocular pressure peaks, troughs & fluctuations recorded for 24 hrs post-operatively

Mean IOP (mm Hg)	Treated Eye n=64 (Mean $\pm$ SD)	Fellow Eye n=64 (Mean $\pm$ SD)	p value (Unpaired 't' test)
Peak	24.1 $\pm$ 3.3	18.5 $\pm$ 2.0	0.000
Trough	14.7 $\pm$ 1.8	11.8 $\pm$ 0.9	0.000
Fluctuation	9.4 $\pm$ 3.6	6.7 $\pm$ 2.0	0.000

#### Correlation of mean intra-ocular pressure recorded for 24 hrs post-operatively

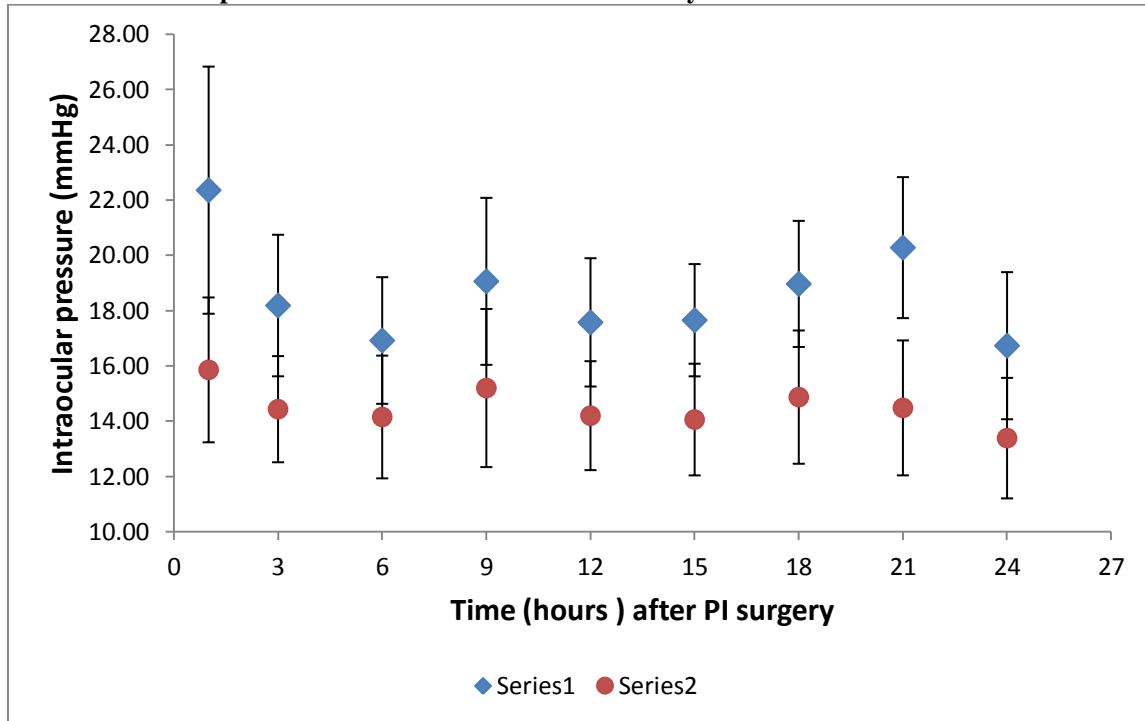
Mean IOP (mm Hg)	Treated Eye n=64 (Mean $\pm$ SD)	Fellow Eye n=64 (Mean $\pm$ SD)	r <sup>2</sup>	p value
Before surgery	34.3 $\pm$ 5.1	15.7 $\pm$ 3.1	0.001	0.773
After 1 hr	22.4 $\pm$ 4.5	15.9 $\pm$ 2.6	0.034	0.143
After 3hrs	18.2 $\pm$ 2.6	14.4 $\pm$ 1.9	0.245	0.000
After 6hrs	16.9 $\pm$ 2.3	14.2 $\pm$ 2.2	0.091	0.015
After 9hrs	19.1 $\pm$ 3.0	15.2 $\pm$ 2.9	0.276	0.000
After 12hrs	17.6 $\pm$ 2.3	14.2 $\pm$ 2.0	0.155	0.001
After 15hrs	17.7 $\pm$ 2.0	14.1 $\pm$ 2.0	0.100	0.011
After 18hrs	19.0 $\pm$ 2.3	14.9 $\pm$ 2.4	0.008	0.486
After 21 hrs	20.3 $\pm$ 2.6	14.5 $\pm$ 2.4	0.001	0.853
After 24hrs	16.7 $\pm$ 2.7	13.4 $\pm$ 2.2	0.221	0.000
Peak	24.1 $\pm$ 3.3	18.5 $\pm$ 2.0	0.014	0.355
Trough	14.7 $\pm$ 1.8	11.8 $\pm$ 0.9	0.000	0.872

Fluctuation	9.4 ± 3.6	6.7 ± 2.0	0.039	0.119
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Mean IOP after iridotomy was 22.4 ± 4.5 mmHg after 1 hour of peripheral iridotomy in treated eyes and 15.9 ± 2.6 mmHg in fellow eyes which was found to be significant (p < 0.05).

Mean intra-ocular pressure trough values after 6 hours were 16.9 ± 2.3 in treated eyes and 14.2 ± 2.2 fellow eyes and after 24 hours in morning hours was 16.7 ± 2.7 mmHg in treated eyes and 13.4 ± 2.2 mmHg in fellow eyes which was found to be significant (p < 0.05).

**Diurnal intra-ocular pressure variation in treated and fellow eyes**



Above chart shows Diurnal intraocular pressure (IOP) patterns of primary angle closure glaucoma patients in affected and fellow eyes. Laser iridotomy was performed in affected and fellow eyes to prevent angle closure attacks. Diurnal IOP was measured for 24 hrs at 3 hrs interval.

**IV. Discussion**

Our study was carried out at JLN Medical College from October 2018 to March 2020 in Upgraded Department of Ophthalmology involving 64 subjects(N=64 treated eyes + N= 64 fellow eyes) of age group more than 20 years including both genders.

Unpaired t- test, chi square test and Pearson’s correlation test were performed. Level of significance was expressed as p- value. P -value of <0.05 was considered as significant.

In our study mean value of the age was 50.5 ± 9.6 years for both treated and fellow eyes. P-value was 1.00 for age group. Most of the study participants were in the age group of 30- 60 years. Among these 37.5% were in age group 50- 60 years and 28.1% were in 40-60 years. Among the 64 subject, 41(64.1%) were females and 23(35.9%) were males in whom PACG was observed. The difference was calculated by chi- square method which was found to be statistically non- significant (p>0.05).In our study, while analyzing the study group we also observed that 64% of total PACG subjects were females. PACG prevalence is more in female population due to shorter axial length as compared to males. Also axial length decreases as age increases.

Mean ± SD values of IOP in PACG subjects before LPI in affected eyes was found to be 34.3 ± 5.1 and in fellow eyes was 15.7 ± 3.1. Mean ± SD values of fundus (C:D ratio) in affected eyes was found to be 0.76 ± 0.06 and fellow eyes was 0.50 ± 0.07. Mean IOP of affected eyes and fellow eyes showed high significant difference (p< 0.05). Mean fundus (C:D ratio) in affected eyes and fellow eyes showed high significant difference (p<0.05).

Mean ± SD values of IOP in PACG subjects after 1 hour of LPI in affected eyes was 22.4 ± 4.5 and in fellow eyes was 15.9 ± 2.6. There was a highly significant difference of IOP between affected eyes and fellow eyes (p<0.05).

In our study, the IOPs of PACG eyes were higher than those of fellow eyes at every time point, including peak and trough IOPs. Post PI peak IOP in treated eyes in 24 hours was  $24.1 \pm 3.3$  mmHg and peak IOP in fellow eyes in 24 hours was  $18.5 \pm 2.0$  mmHg in which p-value was found to be significant ( $p < 0.05$ ). Similarly, postoperatively trough IOP in treated eyes in 24 hours was  $14.7 \pm 1.8$  mmHg and a trough IOP in fellow eyes in 24 hours was  $11.8 \pm 0.9$  mmHg in which p-value was found to be significant ( $p < 0.05$ ).

Mean intra-ocular pressure for fluctuations recorded for 24 hrs post-operatively in treated eyes was  $9.4 \pm 3.6$  mmHg and in fellow eyes was  $6.7 \pm 2.0$  mmHg. There were no significant differences in IOP fluctuation between PACG and fellow eyes ( $p < 0.05$ ).

The diurnal IOP curves for each group showed relatively parallel properties, and the lowest IOP was measured in the morning and peaks were noticed in midnight hours. This may be a result of elevated episcleral venous pressure induced by the supine position at night, which is known to cause nocturnal IOP elevation.

Snow [2] in his study reported that among 72 fellow eyes that did not receive LPI, 43 eyes (59.7 %) experienced APAC.

Thus, prophylactic LPI for normal fellow eyes may reduce future complications and sequelae [3]. Prophylactic LPI is thought to be effective for treatment of intermittent angle closure, asymptomatic shallow anterior chamber angles, or eyes that test positive on glaucoma provocative exams. [4]

Sihota et al. [5] reported that the diurnal IOP for Chronic angle closure glaucoma (CACG) patients who underwent LPI was significantly higher than that of normal controls. We believe that there is a possibility of mild anterior chamber reaction after LPI (i.e., mild anterior uveitis), which may affect fluctuations in IOP.

Baskaran et al. [6] also reported that although the diurnal IOP for APAC patients who underwent LPI was significantly higher than that of normal controls, the diurnal IOP curves of APAC patients and normal controls had relatively parallel properties, with the highest IOP in the morning.

There are a few reasons for high diurnal IOP of PACG affected and fellow eyes. First, a certain level of trabecular meshwork (TM) damage can be caused by PACG. As time goes by, impaired outflow through the TM develops, resulting in increasing IOP. Second, severe inflammation and iris pigment dispersion caused by LPI might damage the TM.

Fellow eyes usually have narrow angles, and thus their IOP is typically higher than that of normal eyes.

## V. Conclusion

In PACG patients mainly females preponderance is noted i.e. 64% due to shorter axial length as compared to males. Axial length also decreases as age increases, so risk of PACG increases. In our study, the IOPs of PACG eyes were higher than those of fellow eyes at every point of time, including peak and trough IOPs and with no significant differences in fluctuations between them. The diurnal IOP curves for each group showed relatively parallel properties, and the trough IOP was measured in the morning hours and peak IOP was measured in midnight hours. Mean daytime IOP decreased from 1 hour after LPI and over time, and was similar to the trend described in both treated eyes and fellow eyes. Fellow eyes of PACG patients are supposed to have narrow angles and thus their IOP is typically higher than that of normal individuals.

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