

EFFECT OF ND: YAG LASER CAPSULOTOMY IN PSEUDOPHAKIC EYES WITH SPECIAL REFERENCE TO IOP CHANGES

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ABSTRACT: BACKGROUND: Nd: YAG laser is non-invasive and effective means to deal with the posterior capsule opacification. However safe it may have some inherent complications. Rise of intraocular pressure is frequently encountered and incompletely understood complication of YAG laser capsulotomy and documented with conflicting results. **AIMS:** Purpose of the study to assess the efficacy of YAG laser capsulotomy in term of visual outcome and also study the complications of the procedure, particularly on IOP. **SETTING:** Tertiary Centre. **DESIGN:** Prospective interventional study. **MATERIAL AND METHODS:** Present study evaluate the changes in IOP and visual acuity after Nd-YAG laser capsulotomy in 280 eyes with significant PCO after uncomplicated small incision cataract surgery with IOL implantation. Complete ocular examination including visual acuity, anterior segment examination with slit lamp, fundus and application tonometry were performed pre-and post-laser in all cases. Posterior capsulotomy was done with Q-switched Nd: YAG laser with energy used < 120mJ. IOP was recorded before and then after laser at 1hour, 2 hour, 3 hour, 24 hour and on seventh day in order to determine the IOP changes. **STATISTICAL ANALYSIS:** The database was collected on a Microsoft Excel (Microsoft Corporation, Redmond, WA) spreadsheet and analyzed using SPSS software 14.0 versions (SPSS, Inc., Chicago, IL). The results were presented in percentages and mean (\pm SD). The categorical/dichotomous variables were compared using Chi-square/Fisher exact test and continuous variables were compared using unpaired t-test. A P < 0.05 was considered significant. **RESULTS:** After laser capsulotomy 91% of case showed improvement in visual acuity by more than two lines in Snellen's vision chart. Transient rise of post laser IOP <5 mm Hg showed in 57% patients within first 2 hours and 33% patients did not developed rise of IOP. Whereas rise of IOP >10 mmHg was found in 5% of cases. Ninety two percent patients achieved base line pressure within 4 hours. Incidence of minor complications was 14.6% and none of patient showed major complications or deterioration of vision. **CONCLUSION:** Our study showed insignificant rise in IOP, and none of patient show vision threatening complication after laser capsulotomy. Hence routine antiglaucoma medicine may not be necessary in all patients following Nd: YAD laser capsulotomy. **KEYWORDS:** Nd: YAG laser, Posterior capsular opacification, Visual acuity, intraocular pressure.

INTRODUCTION: Cataract is the commonest cause of blindness in India. Although, surgical exponents of cataract surgery have achieved best visual acuity in patients, still posterior capsular opacification (PCO) caused by postoperative proliferation of cells in the capsular bag remains a major cause of reduced vision after surgery. Incidence of PCO in early 1990 is about 25 % to 50% by two years post operatively.^[1] In paediatric cataract surgery PCO is a major problem where the incidence approaches 100%.^[2] Modern cataract surgery has been a gradual decreasing in the incidence of this complication by less than 10%.^[3] Hindrance of vision necessitates secondary capsulotomy for visual rehabilitation of patients.

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There are two modalities for posterior capsulotomy – surgical and Nd: YAG laser. Latter is non-invasive, convenient and effective means to deal with the posterior capsule opacification and has largely obviated the need for surgical intervention. [4] Although procedure is safe but rise of intraocular pressure (IOP) is a frequently encountered and incompletely understood complication of YAG laser capsulotomy.

Various studies have evaluated the effect of Nd: YAG laser capsulotomy on intraocular pressure and have given conflicting results. This study has been undertaken to assess the efficacy of YAG laser posterior capsulotomy in terms of visual outcome and also to study the complications of the procedure, particularly its effect on intraocular pressure.

MATERIALS & METHODS: A prospective clinical study to evaluate the changes in IOP and visual acuity after Nd: YAG laser capsulotomy in 280 eyes with visually significant PCO after uncomplicated small incision cataract surgery (SICS) with posterior chamber intraocular lens (PCIOL) implantation carried out from September 2010 to March 2012 in ophthalmology department of a tertiary hospital.

INCLUSION CRITERIA:

- Pseudophakic eye with visual impairment due to significant PCO.
- Minimum period of 3 months following uneventful cataract surgery.
- Co-operative patients those were understood the full implication of the procedure.
- Patient age group >10 years.
- Quiet eye, free of any inflammation.

EXCLUSION CRITERIA:

- Patients with glaucoma or any antiglaucoma medications.
- Diminution of vision due to other factors which were more significant than PCO.

Detailed history was taken regard to duration of surgery, postoperative follow-up period and any significant medical problem. The best corrected visual acuity was noted. A complete ophthalmological examination was done. Slit-lamp examination under mydriasis to assess the thickness, nature and tension lines in PCO, IOP measurement by Goldmann applanation tonometer, fundus examination to rule out any significant posterior segment pathology were done before performing Nd: YAG laser capsulotomy.

Patient underwent Q-switched Nd: YAG laser capsulotomy by using Abraham capsulotomy contact lens. The purpose and nature of the procedure was properly explained and informed written consent was obtained from all patients. The parameters of laser system were adjusted according to the need of the patients, depending upon the type and extent. Minimal possible energy <100mj was used for capsulotomy to clear off the PCO of central 3-4 mm (visual axis).

IOP was recorded by Goldmann applanation tonometer immediately after then 1hour, 2hour, 4 hours of laser application then 24 hours, seventh day and on one month in order to determine the IOP changes. Post laser treatment topical diclofenac eye drop was advised three times a day for seven day. Antiglaucoma medication was given if patients show significant rise in IOP post capsulotomy.

RESULT: In our study age of patients varied from 15 to 75 years with mean age of 58.6 years including 60% male and 40% female. Before laser 18% patients had visual acuity (VA) of $\leq 6/60$ and

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none of patient had VA of 6/9 or more. After laser 32% had VA of $\geq 6/9$ and only 6% patients had VA of $\leq 6/60$. Out of 280 patients 33% cases show no rise of IOP and 57% patients show rise in IOP that was $<5\text{mmHg}$.

Rise of IOP between 6-10 mm Hg, 11-15 and $>15\text{mm Hg}$ was shown in 5%, 3% and 1% patients respectively. Mostly patients (60%) show rise in IOP within 2 hour and mostly (53%) get their baseline IOP within 4 hours, rest of the patients achieve their baseline IOP after 24 hours. None of the patients show elevated IOP after 7 days. Pre laser mean IOP was 15.6 ± 2.3 mm Hg and post laser mean IOP was $17.2 \pm 1.4\text{mm Hg}$.

Sl. No.	Visual Acuity	Patients (Pre laser) No. (%)		Patients (Post laser) No. (%)	
1	6/9-6/6	0	0.0	90	32
2	6/12	40	14.28	50	17.85
3	6/18	50	17.86	78	27.85
4	6/24	83	29.64	30	10.71
5	6/36	55	19.64	14	5
6	6/60	35	12.50	12	4
7	$<6/60$	17	05.06	6	2.11
Total		280	(100)	280	(100)

Table 1: Distribution of cases according to pre & post YAG laser visual acuity

Before laser 18% patients had VA of $\leq 6/60$ and none of patient had VA of 6/9 or more. After laser 32% had VA of $\geq 6/9$ and only 6% patients had VA of $\leq 6/60$.

Sl. No.	Improvement in VA	No. Of cases	Percentage
1	1 line	21	7.5%
2	2 line	136	48.57%
3	3 line	98	35.0%
4	4 line	14	5.0%
5	5 line	04	1.5%
6	6 line	02	0.7%
7	No improvement	05	1.78%
Total		280	100%

Table 2: Improvement in visual acuity following YAG laser capsulotomy

Sl. No	IOP changes mmHg	No. of cases	%
1.	No rise	93	33.34%
2.	1-5	160	57%
3.	6-10	14	5%
4.	11-15	09	3.33%
5.	>15	4	1.33%
TOTAL		280	100%

Table 3: No. of patients with IOP changes after laser capsulotomy

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IOP pressure changes after laser capsulotomy. 187 cases (67%) shows rise in IOP. No pressure elevation was seen in 33% patients. Maximum (57%) show IOP elevation ≤ 5 mmHg and only 10% show IOP elevation >5 mmHg.

Sl. No.	Time interval	Mean IOP	S.D.
1	Pre laser (base line)	13.64	1.74
2	1hr	14.84	2.13
3	2hr	15.64	2.25
4	4hr	14.60	2.10
5	24hr	13.67	1.97
6	7 th day	13.10	1.74
7	28 th day	13.29	157

Table 4: Mean IOP elevation in respect to time interval after YAG-laser capsulotomy

Base line mean IOP was 13.64 ± 1.74 and after laser capsulotomy peak mean IOP was 15.64 ± 2.25 at 2 hours.

Sl. No.	Time interval	No. of patients	%
1.	0-2 hr	168	89.84%
2.	2-4 hr	16	8.56%
3.	After 24 hr	3	1.60%
4.	7day	0	0%
5.	28 th day	0	0%
Total		187	100

Table 5: No. of patients with IOP elevation in respect to time interval after Nd: YAG laser capsulotomy.

Out of 187 patients with IOP elevation, 89.84% of the cases show rise in IOP within 2hr after laser capsulotomy.

Sl. No.	Total Energy (mJ)	No. of cases	Percentage (%)
1.	<20	08	2.67
2.	20-40	72	26
3.	40-60	130	46.2
4.	60-80	56	20
5.	80-100	10	3.40
6.	>100	4	1.34
TOTAL		280	100%

Table 6: Summary of total energy used for laser capsulotomy

Most of the patients (92%) received laser energy in 20-40 mJ.

Type	No. of cases n (%)
Opacities in visual media (floaters)	6 (4)
Hyphaema	1(0.66)
IOL Pitting	6(4)
Raised IOP (>5mm Hg)	14 (9)
Vitreous in anterior chamber	None
Cystoid Macular Edema	None
Retinal detachment	None

Table 7: Complications of Nd: YAG laser capsulotomy

DISCUSSION: Posterior capsular opacification is the most common late complication of even uneventful cataract surgery. PCO may impair contrast sensitivity or may cause glare and remain a major cause of reduced vision after surgery. Nd: YAG laser is the most modern tool to treat posterior capsular opacification with high success rate. The YAG laser was first adopted for eye surgery in 1982 by Franz Fankhauser and Daniel-Aron-Rosa.^[5,6] Nd; YAG laser is an infrared laser has a wave length of 1604 nm. It penetrate through the aqueous with minimum absorption can cut the pigmented and non-pigmented tissue.

Photo disruption focus an intense electromagnetic field of laser stripes electron from atoms and molecules at a focal point causing ionization of tissue (tissue destruction) and creating “plasma”. The rapid expansion of plasma produces shock and pressure waves which create additional mechanical damage around the target site with minimal thermal effect. Visual outcome following Nd: YAG laser posterior capsulotomy:

In our study improvement in visual acuity ≥ 2 lines by Snellen’s vision chart was found in 90.7% of cases and none of patients showed deterioration of visual acuity after laser capsulotomy. Similar observations were seen by Abid Naseem et.al.^[7] MahtabAlam et.al.,^[8] Mohd. Younis. et.al.^[9] they reported significant improvement in visual acuity after laser capsulotomy in >90% of cases. In our study none of patients showed deterioration of vision and about 1.78% cases showed no improvement in visual acuity because of pre-existing fundus pathology which was not detected due to thick posterior capsule opacification.

EFFECT OF YAG LASER POSTERIOR CAPSULOTOMY ON IOP: In our study transient rise in IOP was seen in 67% of patients. Maqsood A. Burq et al.,^[10] Gore V.S.^[11] reported transient and immediate rise in 56.2% and 59.4% of cases respectively which is comparable to our study finding of transient rise in 67% cases. Mohammad YK et al.,^[9] Flohr et. al.^[12] also found IOP elevation in 84% and >75% of cases respectively in their studies. In our study 67% patients show insignificant rise of IOP after laser capsulotomy.

Out of these 85% cases had increase of IOP up to 5 mm Hg and 7% had risen of IOP >10 mm Hg after laser capsulotomy. Our results were concordance with study conducted by Hassan KS et. al.^[13] and Kraff CM et al^[14] reported average rise in IOP by 6 mm Hg and 3.5 mm Hg after laser capsulotomy respectively. Channel MM et al,^[15] Morique J.J. Leys et al.^[16] and Shubert H.D. et al^[17] reported >10 mm Hg of IOP rise in 59%, 29% and 15% cases respectively.

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The incidence given by various authors and those found in our study are variable which may be due to use of higher energy and larger capsulotomy as explained in their studies. Various other factors documented in different studies explain for rise of IOP after laser capsulotomy were presence or absence of IOL, sulcus or bag fixation of IOL, pre laser IOP, glaucomatous patients, different time period of IOP recording, type of PCO, size of capsulotomy, initial pulse energy, treatment given etc.

The IOP rise may also correlated with high IOP before laser capsulotomy. Higher the pre-treatment IOP leads to greater the chance of high pressure rise. In our study the baseline pre-laser mean IOP was 13.64 ± 1.74 mm Hg which increased to 14.82 ± 2.13 mm Hg at 1 hour and peaked to 15.64 mm Hg by 2 hour after laser capsulotomy and then start declining towards pre laser value and return to baseline value by 4 hours in 80% cases without any anti-glaucoma medication. Our study corresponds with the study conducted by Dawood Z et.al.^[18] and Ge J et.al.^[19]

They reported transient peak rise of IOP within 1-3 hour and 1.5- 4 hour after laser capsulotomy respectively and return to baseline value within 24 hours in their study. The sudden pressure rise is caused by impaired aqueous outflow and rapid onset suggest that the reduced outflow mostly due to clogging of trabecular meshwork by capsular debris, acute inflammatory cells, heavy molecular weight protein or a combination of these mechanisms. IOP rise and total energy used in the procedure - In our study the total energy used for capsulotomy ranged from 12 mJ to 120 mJ.

There are comparatively more number of cases showing IOP rise in higher energy levels (>50mJ), but there was no significant linear correlation found between energy used and IOP rise after laser capsulotomy ($p=0.179$). Our results are also favored by various studies conducted by Arlo C Terry et. al.^[20], Kraff et. al.^[14] Flohr et. al.^[12] Dawood Z et. al.^[18] and Mahtab AK et.al.^[8] In contrast to our study significant correlation was found between IOP elevation and energy used by Mohammad W et.al.^[21] and Claudia U. Richer et. al.^[22] they identified >200 mJ energy as a factor that tend to increase patients risk of having a more pronounced pressure rise after pulsed laser discission.

COMPLICATIONS FOLLOWING ND: YAG LASER CAPSULOTOMY: Damage to IOL: Damage to IOL can occur in various forms after YAG laser capsulosmy such as voids or pits, micro-cracks and large pulverized lesions. In our study out of 300 pseudophakic patients pit marks on IOL were found only in 2% cases. Zafar Dawood et al.^[18] Ejaz AJ et. al.^[23] and Abid N et al.^[7] also reported IOL pitting in 0.5%, 3.33%, and 4% of cases respectively in their studies. The pitting on depend upon the surgeon's experience, type of laser machine, better focusing and patients movement etc.

Debris/flakes cortical matter in ocular media: In our study 5.5% of cases complaints of floaters due to release of debris, micro particles and capsular tags in vitreous especially in patients had thick capsule or pearls type of PCO. These complaints resolve within 3 weeks in all cases. Abid N et al.^[7] documented vitreous opacities in 2% cases this is similar to our finding and Mohammad YK et al.^[9] recorded debris in anterior chamber in 17.2%, this finding is related to use of laser in aphakic eyes and use of higher energy for laser capsulotomy.

We found lesser incidence as compared to these study groups most probably because most of the patients in our study were pseudophakic, with in the bag implanted IOLs. These must have acted as a barrier for the cortical matter. Hyphaema: In our study 0.7% patients had transient hyphaema during YAG laser capsulotomy.

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Various authors: Stark et al,^[24] Flohr et al^[12] Mohammad YK et al.,^[9] Gore V.S.^[11] were also found similar incidence of hyphaema 1%, 9%, 1.7% and 1.5% respectively in their studies. The bleeding was slight and the procedure was completed without any difficulty. Hyphaema was resolved spontaneously in 24 hours. Cystoid macular edema and retinal detachment:

Some other complications like cystoids macular edema (CME) and retinal detachment were encountered in other studies, but not in our study. Similarly Auranzeb Set. Al.^[25] also reported incidence of CME in 0.3% of cases and no case of RD in their study. They concluded laser capsulotomy is almost safe procedure when performed six months after cataract surgery. Douglas D et al.^[26], Barbosa A et al.^[27], reported incidence of retinal detachment 2.5%, 3.5% respectively in their study.

Mohammad YK et al.^[9], Mahtab AK et al.^[8], Gore V.S.^[11] reported incidence of CME 1.7%, 0.6% and 4% respectively in their study. The cause of higher incidence of these complications may be because these studied were conducted for longer follow up period and of time 6 months to 2 years. They also noticed influence of total energy on complications was significant.

CONCLUSION: In our study 91% cases shows improvement in vision by ≥ 2 lines and none of patients showed deterioration of visual acuity after laser capsulotomy. Insignificant rise (≤ 5 mmHg) in intraocular pressure in most of the patients and none shows vision threatening complication after capsulotomy. Thus Nd: YAG laser capsulotomy is an effective, safe, fast and non-invasive technique to improve hindered vision by PCO. To avoid severe complications it is suggested that energy level should be kept to a minimum level and use with some degree of caution and vigilance. This study has limitations. The sample was small and represents the results at a single Centre only. The results were based on short-term follow-up period.

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