

## Original Article

# Effects of Nd:YAG Laser capsulotomy and its complications

<sup>1</sup>Dr O P Anand , <sup>2</sup>Dr S K Choudhary , <sup>3</sup>Dr Saloni Gupta

<sup>1</sup> HOD, EYE Department, NRCH

<sup>2</sup> Sr DMO, Eye Department, NRCH

<sup>3</sup> ADMO, Eye Department, NRCH

Northern Railway Central Hospital, New Delhi

Corresponding Author: Dr O P Anand

## ABSTRACT

**Introduction-** Posterior capsular opacification is the most common late post – operative complication of Cataract surgery which is treated by Nd YAG Capsulotomy.

**Aim-** To report changes in visual acuity, contrast sensitivity, refractive status and various complications arising from post treatment with Nd – YAG Laser.

**Materials and Method** – This was a prospective study which included 100 eyes of 87 patients who underwent Nd :YAG Laser capsulotomy at the outpatient service of NRCH. The laser was delivered through a slit lamp delivery system after aiming by helium-neon beam. Post-treatment follow ups were performed at Day1, 1<sup>st</sup> week, 1<sup>st</sup> Month and 3<sup>rd</sup> Month. At every visit Visual Acuity, Near Vision, Contrast Sensitivity, Intraocular Pressure and a detailed slit lamp and fundus examination to find out complications arising post treatment was recorded. Refraction was performed at 1 month and after 3 months to find out the best corrected visual acuity.

**Results** - In our study, pre-laser visual acuity ranged from 6/12 to finger counting at 1 metre and 57% cases achieved visual acuity of 6/9 on D1 of capsulotomy and on D7, 62% cases had visual acuity of 6/9 and 14 % achieved visual acuity of 6/6. It showed statistically significant improvement in visual acuity at D1, D7, 1<sup>st</sup> and 3<sup>rd</sup> month. Pre laser value of contrast sensitivity and near vision was compared with mean value during follow up and improvement was found to be statistically significant.

**Conclusion** - Nd:YAG capsulotomy for posterior capsular opacification significantly improves visual parameters including visual acuity, contrast sensitivity and brightness.

## Introduction

Posterior capsular opacification (PCO) is the most common late post-operative complication of cataract surgery occurring in up to one-third of patients in a period of five years. PCO is a major problem in paediatric cataract surgery where the incidence approaches 100%. It causes a slow decline in visual quality as well as quantity and hence is referred to as secondary cataract. There are two types of PCO; Soemmering's ring and Elsching's pearl.

The current treatment of choice is laser Nd YAG Capsulotomy (neodymium-doped yttrium aluminum garnet). It is a non-invasive office procedure and has completely replaced surgical capsulotomy. It is a solid state laser that delivers pulses in near infrared.

Common indications include diminished visual acuity, glare, decreased vision and inadequate fundus view. Although the procedure is simple and convenient, it is associated with few complications like IOL pitting, transient rise of IOP, iritis, cystoid macular oedema and anterior hyaloid disruption and other less common complications like RD and endophthalmitis.

In the present study, we report the changes in visual acuity, contrast sensitivity, refractive status and various complications arising post treatment with Nd YAG laser.

### **Methods**

This was a prospective study which included 100 eyes of 87 patients who underwent Nd : YAG Laser capsulotomy at the outpatient services of Northern Railway Central Hospital, New Delhi. Patients who had come back after an uncomplicated cataract surgery with decreased vision or glare after a period of at least 3 months from the day of surgery were included in the study. All those patients with any attributable cause other than posterior capsular opacification were excluded from the study. Approval from the institutional ethic committee and proper informed consent from each participant was obtained.

### **Procedure:**

The laser was delivered through a slit lamp delivery system after aiming by helium-neon beam. Nd:YAG laser is a solid state laser that delivers pulses in the near infrared (1064 nanometers). It concentrates very small amounts of energy into high peak power by delivering energy in a short time, promoting optical breakdown and causing plasma formation with a resultant shock wave. Because the Nd:YAG laser beam is invisible, a helium-neon (HeNe) laser beam is used as focusing device.

Capsulotomy was performed by applying a series of punctures in a cruciate pattern. An opening of about 3 mm to 3.5 mm was created at the visual axis. Minimal energy 0.8 to 1.0 mJ was given per shot with single pulse and offset of 150 and shots were placed across the tension lines. The usual strategy was to create cruciate openings beginning at 12 o'clock periphery and progress towards 6 o'clock position and cut across 3 o'clock and 9 o'clock position. Any residual tags were cleaned to avoid freely floating fragments. Post treatment topical antibiotic and steroid drops were prescribed for a week. An Intraocular Pressure (IOP) lowering agent was used for patients with significantly elevated IOP.

Cruciate openings have several advantages; the initial shots are in the periphery so that if the patient startles and an adjacent IOL is marked, the mark appears in the periphery. Both the patient and the surgeon have settled down before the more critical central area is treated. Gravity aids in pulling the flaps as they develop towards inferior periphery.

### **Follow up**

Post-treatment follow ups were performed at Day1, 1<sup>st</sup> week, 1<sup>st</sup> Month and 3<sup>rd</sup> Month. At every visit Visual Acuity, Near Vision, Contrast Sensitivity, Intraocular Pressure and a detailed slit lamp and fundus examination to find out complications arising post treatment was recorded. Refraction was performed at 1 month and after 3 months to find out the best corrected visual acuity.

### **Results**

A total of 100 eyes of 87 patients (61 males and 39 females) were included in the study. 64% cases had pearls type of PCO and 36% had fibrous type. In the study pre-laser visual acuity (VA) ranged from 6/12 to finger counting at 1metre. On Day1 visual acuity improved from pre laser VA of 6/12, 6/18, 6/24 improved to 6/9 post laser in 100%, 73% and 63% cases respectively. In patients with pre laser VA of 6/36 and 6/60, gained 6/12 or better in 75% and 60% cases respectively. One case showed dramatic change with VA Finger Counting at 1m to post laser 6/18. Similarly, on Day 7 of capsulotomy cases with VA of 6/18, 6/24, 6/36 gained 6/9 or better vision in 90%, 84% and 50% cases respectively. Patient with pre laser FC at 1m improved to 6/9. At one month, cases with 6/18 and 6/24 pre laser VA gained 6/9 VA in 92% and 88% cases respectively.

|                               |           | Percentage of Cases Achieving Post Laser Va 6/9 |      |           |          |
|-------------------------------|-----------|---|------|-----------|----------|
| Pre Laser<br>Visual<br>Acuity |           | Day1  | Day7 | 1st Month | 3rdMonth |
|                               | BCVA 6/12 | 100   |      |           |          |
|                               | BCVA 6/18 | 73  | 90   | 90        | 90       |
|                               | BCVA 6/24 | 63  | 84   | 92        | 92       |
| BCVA 6/36                     | --        | 50  | 88   | 88        |          |

**Table1. Improvement from Pre Laser to Post Laser in Visual Acuity**

The improvement in VA and Near Vision at Day 1, Day 7, 1st month and 3rd month was found to be statistically significant. However, BCVA at 3 months remained same as 1 month.

There was statistically significant improvement in contrast sensitivity from pre laser mean value (1.1538) to post laser mean value (1.5235).

|                    | C.S. PRE<br>LASER | C.S. D1 | C.S. D7 | C.S. 1<br>MONTH | C.S. 3<br>MONTHS |
|--------------------|-------------------|---------|---------|-----------------|------------------|
| N                  | 100               | 100     | 100     | 100             | 100              |
| Minimum            | .60               | 1.20    | 1.20    | 1.20            | 1.20             |
| Maximum            | 1.65              | 1.80    | 1.80    | 1.80            | 1.80             |
| Range              | 1.05              | .60     | .60     | .60             | .60              |
| Mean               | 1.1538            | 1.5235  | 1.5235  | 1.5220          | 1.5220           |
| Std. Deviation     | .22624            | .13074  | .13074  | .13358          | .13358           |
| Median             | 1.2000            | 1.5000  | 1.5000  | 1.5000          | 1.5000           |
| Std. Error of Mean | .02262            | .01307  | .01307  | .01336          | .01336           |

**Table 2. Pre-Laser And Post-Laser Contrast Sensitivity**

Refraction was done before capsulotomy, at 1 month and 3 months of capsulotomy. About 77% cases had no change in spherical equivalent, 7 cases had hypermetropic shift of +0.25D, 8 cases had hypermetropic shift of +0.5D, 4 cases had myopic shift of -0.25D and 4 cases had myopic shift of -0.5D. There was no change in cylindrical component in 62% cases, 9% had -0.5D shift, 16% had -0.25D shift, 4% had +0.25D shift, 7% had +0.5D shift and 2% cases had +1.0D shift.

In comparison to mean baseline Pre- Nd: YAG laser value of 16.07(+/-2.4), a rise in the intraocular pressure values after 3 hrs of laser was observed with mean value 18.14(+/-3.4) which showed a high statistical significance (p value =.000). Mean IOP on D1 was 17.18(+/-3.3), and D7 was 16.75(+/-3.02) with (p value.000 and .001) which was again statistically significant.

|                    | IOP PRE LASER | IOP 3 HRS | IOP D 1 | IOP D 7 | IOP 1MONT H | IOP 3MONTHS |
|--------------------|---------------|-----------|---------|---------|-------------|-------------|
| N                  | 100           | 100       | 100     | 100     | 100         | 100         |
| Minimum            | 10            | 8         | 9       | 8       | 10          | 9           |
| Maximum            | 21            | 25        | 24      | 24      | 23          | 22          |
| Range              | 11            | 17        | 15      | 16      | 13          | 13          |
| Mean               | 16.07         | 18.14     | 17.18   | 16.75   | 16.20       | 16.10       |
| Std. Deviation     | 2.438         | 3.496     | 3.341   | 3.020   | 2.796       | 2.751       |
| Median             | 16.00         | 17.50     | 17.00   | 16.00   | 16.00       | 16.00       |
| Std. Error of Mean | .244          | .350      | .334    | .302    | .280        | .275        |

**Table 3. Change In IOP After Nd:YAG Capsulotomy**

Out of 100 eyes, 9% developed pitting, 10% had mild anterior uveitis, 3% had anterior hyaloid disruption, and 2% developed cystoid macular oedema. None of the patients developed retinal detachment or endophthalmitis.

| COMPLICATION                      | NO. OF EYES | PERCENTAGE |
|-----------------------------------|-------------|------------|
| IOL Pitting                       | 9           | 9%         |
| Anterior uveitis                  | 10          | 10%        |
| Anterior Hyaloid Disruption (AHD) | 3           | 3%         |
| Cystoid Macular Edema (CME)       | 2           | 2%         |
| Retinal Detachment (RD)           | 0           | 0%         |
| Endophthalmitis                   | 0           | 0%         |

**Table 4. Complications Of Nd:YAG Laser Capsulotomy**

**Discussion**

Improvement in visual acuity and contrast sensitivity are the main aims for successful YAG laser posterior capsulotomy. In our study, pre-laser visual acuity ranged from 6/12 to finger counting at 1 metre and 57% cases achieved visual acuity of 6/9 on D1 of capsulotomy and on D7, 62% cases had visual acuity of 6/9 and 14 % achieved visual acuity of 6/6.

Our study showed statistically significant improvement in visual acuity at D1,D7,1month and 3 month which was found comparable to other studies by Hossain MI et al. Pre laser value of contrast sensitivity was compared with mean value during follow up and improvement was found to be statistically significant. Improvement in near vision was highly significant .

Refraction was done before capsulotomy, at 1 month and 3 months of capsulotomy. The magnitude of the shift is a function of the intraocular lens style and capsulotomy size. A bigger capsulotomy is found to be associated with increased backward movement. All the patients in our study had foldable intraocular lens and the capsulotomy size was 3.5 to 4 mm. , Change in cylindrical component was similar to spherical component in the range of 0.25D to 0.5D which was not significant.

About 17% cases in our study had significant rise in IOP (>5mmHg elevation from baseline) after 3hrs of capsulotomy. The contributing factors of rise of IOP could be dilated pupil, uveitis, entrapment of capsular fragments and debris from capsulotomy in the filtration angle. About 13% had >5mmHg elevation from pre-laser values on D1, out of which 8 patients had IOP within normal range. On D7, only 3% cases had >5mmHg elevation from pre-laser IOP. None of the patients had persistently elevated IOP at 1month and 3 months. In an FDA cohort, the maximum elevation of IOP occurred between 1.5 and 4 hours after laser treatment Results by Slomovic and Parrish<sup>58</sup> mirrored the FDA's findings. The initial laser spots were placed off-center to avoid inadvertent damage to the IOL near the visual axis and a focus offset control was used to allow the laser beam to be placed posterior (up to 150 micron) to the HeNe beam focus point on the capsule. IOL pitting in our study was not visually significant.

Mild anterior uveitis in 10 patients on Day 1 of capsulotomy. None of the patients had uveitis on subsequent visits. In our study, 2 patients developed cystoid macular edema. Further improvement in visual acuity in these 2 cases was not found at follow up period of 3 months. This observation was consistent with Steinert and associates . In our study none of the patients developed retinal detachment.

### **Conclusion**

Nd:YAG capsulotomy for posterior capsular opacification significantly improves visual parameters including visual acuity, contrast sensitivity and brightness.

Visual recovery is immediate and maximum improvement occurs within 1 month. There is an insignificant change in the refractive status of eye with this procedure, so routine refraction following Nd:YAG capsulotomy is not required in most of the cases. As per our study there is a definite chance of increase in IOP especially in first few hours of capsulotomy , hence IOP monitoring should be done after capsulotomy. Damage to intraocular lens is not visually significant in our study but there is definite chance of pitting. Other complications are not clinically significant.

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