

## OUTCOMES OF NEODYMIUM YTTRIUM ALUMINUM GARNET (ND:YAG) LASER CAPSULOTOMY IN PATIENTS WITH POSTERIOR CAPSULAR OPACIFICATION

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Best Corrected Visual Acuity, Central Macular Thickness, Intraocular pressure, Nd:YAG Laser Capsulotomy, Posterior Capsular Opacification

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### Abstract

**Objective:** To determine the pre and post outcomes of Nd:YAG Laser Capsulotomy in Patients with Posterior Capsular Opacification

**Study design:** Quasi experiment

**Place of the study:** Department of Ophthalmology, Civil Hospital, Karachi Karachi, over a period of six months.

**Methodology:** A total of 100 patients with visually significant PCO, underwent for Nd: YAG capsulotomy, age group between 18-70 years of either gender were included in the study via non-probability sampling technique. Each participant received a complete ophthalmic evaluation that involved the best-corrected visual acuity with a Snellen chart, Goldmann applanation tonometry to measure the IOP and optical coherence tomography for CMT. After that patients underwent for ND-YAG posterior capsulotomy procedure. The best-corrected visual acuity, IOP and CMT were measured again at two weeks of the post-procedure follow-up visit. Data was entered and analyzed using SPSS version-26. Mean  $\pm$  SD were calculated for age, BMI, IOP & CMT. Frequency and percentage was calculated for gender, side of eye and BCVA. Paired independent t-test was applied to compare the pre and post CMT, IOP and BCVA. Mc-nemer test was applied to compare pre and post BCVA. P-value  $\leq$  0.05 was taken as significant.

**Results:** 100 PCO patients were included, the sex predilection was not present among the patients and were treated with Nd YAG laser. Males were 54 and females were 46 with mean age was  $51.91 \pm 5.71$  years. mean CMT was  $250.73 \pm 62.15 \mu\text{m}$  and post procedure CMT was  $261 \pm 59 \mu\text{m}$  with significant difference as p-value = 0.000. All patients showed a temporary rise in the intraocular pressure values after ND YAG laser capsulotomy with statistically significant difference as p-value = 0.000 which return to near normal of the base line values at the 1 week of follow up. The pre laser Best Corrected visual acuity (BCVA) of around 83% of eyes was between 6/18 and 6/60, while post procedure, 14% had  $\geq$  6/6 and remaining all patients i.e. 84% had between 6/9 to 6/12. None of these eyes showed further deterioration in BCVA

**Conclusion:** Nd:YAG laser therapy presented the advantage of a noninvasive, effective, relatively safe technique to manage posterior capsular opacity.

## INTRODUCTION

Since the recognition of cataract, its removal was recommended and practiced in the ancient era. As the evolution of cataract surgery continued from couching, preliminary techniques of extracapsular cataract extraction to intracapsular cataract extraction, high incidence of complications after intracapsular cataract extraction such as vitreous loss, cystoid macular oedema and retinal detachment, triggered the search for perfection.<sup>1,2</sup> In the last two decades resurgence of refined techniques of extracapsular extraction, not only reduced the rate of complications but also, intact posterior capsule encouraged implantation of posterior chamber intraocular lens (IOL) for attaining better visual results. Since the development of extracapsular cataract extraction and phacoemulsification and adaptation of the procedure as being the standard one globally, its after effects are studied meticulously.<sup>3</sup> After cataract (PCO) is a natural consequence of extracapsular cataract extraction and phacoemulsification. Overall incidence of 25% has been reported for PCO after extracapsular cataract extraction within 5 years of surgery.<sup>4</sup> As a result of this opacification, there is gradual deterioration of visual function which ultimately become symptomatic in the form of decreased VA, decreased contrast sensitivity, glare or even monocular diplopia.<sup>5</sup> The PCO develops in months to years postoperatively. In younger age groups it develops earlier but in elderly, its incidence declines.<sup>6</sup> Since the use of Neodymium-YAG laser for posterior capsulotomy, this procedure has been gradually replacing the surgical capsulotomy as it is less invasive, safe and can be performed as an outpatient procedure. Size of capsulotomy should be according to the purpose of the procedure.<sup>7</sup> Optical purposes need 2-3mm while therapeutic need large size capsulotomy. It should be noted that capsular opening created with Neodymium-YAG laser tends to increase in size with smoothing of edges from capsular tag retraction and may become circular.<sup>8,9</sup> Posterior capsular opacification (PCO) or secondary cataract is the most common long-term complication

of modern cataract surgery.<sup>10</sup> Moreover, it is the common determining factor for visual outcomes following phacoemulsification. The current study was designed to determine the pre and post outcomes of Nd:YAG Laser Capsulotomy in Patients with Posterior Capsular Opacification. Since the use of Neodymium-YAG laser for posterior capsulotomy, this procedure has been gradually replacing the surgical capsulotomy as it is less invasive, safe and can be performed as an outpatient procedure. Very less literature is available in this regard. Due to scarcity of data the work on this subject persuaded us for conducting this study.

## Methodology:

This study was conducted over a period of six months in the department of Ophthalmology, Civil Hospital, Karachi. A total of 100 patients with visually significant PCO, underwent for Nd: YAG capsulotomy, age group between 18-70 years of either gender were included in the study via non-probability sampling technique after the provision of written informed consent. Patients with thin PCO not affecting visual acuity, patients not having previous records of surgical procedure, and known cases of glaucoma were excluded. The sample size was calculated using OPENEPI sample size calculator by using that mean IOP before laser was  $14.5 \pm 1.9$  (mmHG) and post laser, it was  $14.7 \pm 1.8$ ,<sup>7</sup> level of significance = 5%, power of study = 80%, then calculated sample size was 2688. Due to less turnover of the patients, authors can included around 100 patients. Demographic details of the patient like age, gender, height, weight and BMI of the patients was noted. Each participant received a complete ophthalmic evaluation that involved the best-corrected visual acuity with a Snellen chart, Goldmann appplanation tonometry to measure the IOP and optical coherence tomography for CMT. After that patients underwent for ND-YAG posterior capsulotomy procedure. One percent tropicamide was used for the dilation of pupils before surgery. The best-corrected visual acuity, IOP and CMT were

measured again at two weeks of the post-procedure follow-up visit. Data was entered and analyzed using SPSS version-26. Mean  $\pm$  SD were calculated for age, BMI, IOP & CMT. Frequency and percentage was calculated for gender, side of eye and BCVA. Paired independent t-test was applied to compare the pre and post CMT and IOP. Mc-nemer test was applied to compare pre and post BCVA. P-value of  $\leq 0.05$  was taken as significant.

**Results:**

A total of 100 eyes were included of the patients had mean age  $51.91 \pm 5.71$  years. 54 (54%) were male and 46 (46%) were female, as shown in table #1. Pre and post visual outcomes of Nd:YAG Laser Capsulotomy in Patients with Posterior Capsular Opacification were analyzed, mean CMT was

$250.73 \pm 62.15 \mu\text{m}$  and post procedure CMT was  $261 \pm 59 \mu\text{m}$  with significant difference as p-value = 0.000. The results of the study showed that, all the 100 patients showed a temporary rise in the intraocular pressure values after ND YAG laser capsulotomy with statistically significant difference as p-value = 0.000 which return to near normal of the base line values at the 1 week of follow up. The pre laser Best Corrected visual acuity (BCVA) of around 83% of eyes was between 6/18 and 6/60, 7% had between 6/9 to 6/12, 10% had  $< 6/60$  and none of the patient had  $\geq 6/6$ , while post procedure, 14% had  $\geq 6/6$  and remaining all patients i.e. 84% had between 6/9 to 6/12. None of these eyes showed further deterioration in BCVA, as shown in table#2.

**Table#1: Demographic Data of the Patients**

Demographic Data	(mean $\pm$ sd)/n(%)
Age (Years)	51.91 $\pm$ 5.71
Gender	
<ul style="list-style-type: none"> <li>• Male</li> <li>• Female</li> </ul>	54 (54%) 46 (46%)

**Table#2: Analysis of pre and post visual outcomes of Nd:YAG Laser Capsulotomy in Patients with Posterior Capsular Opacification**

Visual Outcomes	Pre- Nd:YAG Laser Capsulotomy	Post- Nd:YAG Laser Capsulotomy	P-value
Central Macular Thickness ( $\mu\text{m}$ )	250.73 $\pm$ 62.15	261 $\pm$ 59	0.000
Intraocular Pressure	10 $\pm$ 2	16 $\pm$ 1.5	0.000
Best-Corrected Visual Acuity			
<ul style="list-style-type: none"> <li>• 6/18 and 6/60</li> <li>• 6/9 to 6/12</li> <li>• <math>&lt; 6/60</math></li> <li>• <math>\geq 6/6</math></li> </ul>	83 (83%) 7 (7%) 10 (10%) 0 (0%)	0(0%) 84 (84%) 0(0%) 14 (14%)	0.000

**Discussion:**

Posterior capsular opacification (PCO) is among the commonest post-cataract surgery complications. Nd: YAG capsulotomy is the conventional method used to treat PCO. Nd: YAG laser has a wavelength of 1064 nm.<sup>11</sup> This laser disrupts ocular tissues by creating a short, high-power pulse resulting in an

optical breakdown. Optical breakdown leads to ionization or plasma formation generating acoustic and shock waves, causing tissues disruption. The laser settings are dependent upon the density of the PCO and vary from 2-6 mj per spot. Typically, 10-30 laser shots are required. Nd: YAG laser posterior capsulotomy has been proven effective in reversing

the decreased visual acuity after PCO formation.<sup>12</sup> Similarly, studies have documented improvements in contrast sensitivity and glare.<sup>13</sup> However, the procedure is associated with complications such as intraocular lens (IOL) pitting or subluxation, a transient spike of intraocular pressure (IOP), corneal edema, and cystoid macular oedema raised risk of retinal detachment and delayed post-op endophthalmitis.<sup>14</sup> Parajuli et al, concluded from their study that best -corrected visual acuity (BCVA) improves significantly after Nd: YAG laser posterior capsulotomy.<sup>15</sup> Similarly, many other researchers, including Khambhiphant et al, and Oztas et al, documented an improvement of the best-corrected visual acuity following Nd: YAG laser posterior capsulotomy.<sup>16,17</sup> One study conducted in India to evaluate effect of Neodymium: Yttrium Aluminum Garnet Laser Capsulotomy on Visual Acuity in Patients with Posterior Capsular Opacity in a Tertiary Care Hospital and revealed that Out of 72 eyes, 86.2% (62 eyes) had BCVA between 6/18 and 6/60. Among the remaining 13.8%, 9.7% (7 eyes) had BCVA Of less than 6/60 and 4.1% (3 eyes) had BCVA of 6/9 to 6/12, and nobody had a vision of 6/6 or better. After Nd-YAG capsulotomy, patients showed significant improvement in vision, 87.5% (63 eyes) showed BCVA of better than 6/12, and 33.3% (24 eyes) had BCVA of 6/6.<sup>6</sup> Our study also showed a marked improvement in the best corrected visual acuity.

It has been reported that rise in IOP after YAG occurs due to reduced outflow facility secondary to blockage of trabecular meshwork by the capsular debris and vitreous particles floating in the anterior chamber.<sup>18</sup> Some studies have shown that higher elevation of IOP was noticed in larger capsulotomies. It showed that size of the Nd: YAG capsulotomy was an important factor in IOP spikes.<sup>19</sup>

The maximum increase in intraocular pressure is seen 1 - 2 hours after the procedure and many ophthalmologists recommend anti-glaucoma treatment for seven days after the procedure. The medications preferred are  $\alpha 2$  adrenergic receptor agonists such as apraclonidine 0.5% as ocular hypotensives.<sup>20</sup> In this particular study there was insignificant rise of IOP which did not require any post-laser medication. Thus all pseudophakic patients do not require antiglaucoma medication

pre, or post Nd YAG laser capsulotomy. Another researcher found that only patients who required more than 40 shots for capsulotomy needed a close observation.<sup>20</sup> The effect of Nd:YAG Laser Capsulotomy on Refraction and Anterior Segment Parameters in Patients with Posterior Capsular Opacification was determined, in which it has been stated that mean IOP before laser was  $14.5 \pm 1.9$  (mmHG) and post laser, it was  $14.7 \pm 1.8$ .<sup>7</sup> Our results are in agreement with the findings of a study conducted in India to evaluate the IOP and macular thickness after ND-YAG laser capsulotomy.<sup>21</sup> In the current study findings, significant difference existed in CMT when compared preoperatively and two weeks postoperatively. Our results are in agreement with findings reported by a 2015 study conducted by Yuvacı et al., CMT was measured by Yuvacı et al. They measured CMT of 28 patients who were subjected to ND-YAG Posterior capsulotomy procedure for PCO. They measured changes in the thickness of the central macula following ND-YAG posterior capsulotomy at an interval of one day, then three days, then after two weeks, and finally after 4 weeks. On the first postoperative day, an increase in CMT was reported. This increase was reverted on the third postoperative day and values on the second, fourth, and 12th weeks were similar to the values on the first day. They did not report any statistically significant change in CMT at any interval.<sup>22</sup>

## LIMITATIONS OF STUDY:

Our study had limitations as variables like the type of IOL material; the type and degree of posterior capsular opacification were not considered. Hence, further studies are encouraged on large data sets to determine the statistical significance of our observed findings.

## CONCLUSION

To conclude modified round pattern Nd: YAG laser posterior capsulotomy can be performed safely and achieves rapid visual rehabilitation. Since with this novel methodology, one can immediately assess the visual improvement after the procedure and the possibility of reduced floaters, the modified round pattern method of Nd: YAG laser posterior capsulotomy can be considered an excellent alternative procedure.

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