

# Effect of Neodymium: Yttrium-Aluminium-Garnet Laser Posterior capsulotomy on refractive status of the Eye

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## Author's Contribution

<sup>1,2</sup> Conception of study

<sup>1,2,3,4</sup> Experimentation/Study conduction

<sup>1,2,3,4</sup> Analysis/Interpretation/Discussion

<sup>1,2</sup> Manuscript Writing

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## Abstract

**Objective:** To assess the effect of Neodymium: Yttrium-Aluminium (Nd: YAG) laser posterior capsulotomy on the refractive status of the eye.

**Setting:** This Quasi-experimental study was conducted at the Outpatient department of Benazir Bhutto Hospital, Rawalpindi from 1st January 2017 to 30th June 2017.

**Materials and Methods:** A total of 95 eyes of 95 patients were included in this study. The patients were selected based on non - randomized convenient sampling. Among these patients 49 were females and 46 were males. The age range was 43 years to 85 years. These patients were those who had undergone uncomplicated cataract surgery with intraocular lens implantation 6 months or more than 6 months before presentation with posterior capsular opacification. Before Nd: YAG laser posterior capsulotomy, complete anterior and posterior segment examinations of these patients was performed and they were found to have no other associated anterior or posterior segment pathologies. Post YAG capsulotomy, Autorefractometre readings were recorded again on the same day, at 1 week and the end of 4 weeks. Readings at the end of 4 weeks were considered for result purposes.

**Results:** Data was analyzed through the SPSS version 18. The mean age was 60.14 years with a standard deviation of 9.241. Spherical equivalents were compared before and after YAG capsulotomy. Wilcoxon signed ranks test was applied. P-value (0.70) was found to be statistically insignificant which supported our hypothesis.

**Conclusion:** Nd: YAG laser capsulotomy does not change the refractive status of the eye.

**Keywords:** Posterior capsular opacification, Nd: YAG laser, Posterior capsulotomy, Spherical equivalent.

## Introduction

One of the common delayed complications that result in reduced vision after uneventful cataract surgery with intraocular lens implantation is posterior capsular opacification.<sup>1</sup> Incidence of PCO is 18% to 15%.<sup>1</sup> The modern procedure of cataract extraction involves the creation of a capsular bag that comprises a part of the anterior capsule and complete posterior capsule.<sup>2</sup> Some cells persist on the anterior capsule which causes proliferation of the lens fibers which results in coverage of the previously cell-free posterior capsule, resulting in a reduction of the visual acuity when the opacification involves the visual axis.<sup>2,3</sup> Many techniques have been adopted along with the modern phacoemulsification techniques to reduce the incidence of the posterior capsular opacification but it remains the most common postoperative delayed complication encountered after cataract surgery.<sup>4-6</sup>

The recommended treatment of posterior capsular opacification is by capsulotomy using Neodymium: Yttrium-Aluminium-garnet (Nd: YAG) laser.<sup>7</sup> Photodisruption of the posterior capsule is caused by the Nd: YAG laser which clears the visual axis. The use of Nd: YAG laser for posterior capsulotomy has been reported to cause a posterior dislocation of the intraocular lens which can result in a change in the refractive status of the eye. If this change is significant, it can cause deterioration of the visual acuity of the patient.<sup>8</sup>

Our hypothesis is that no change occurs in the refractive status of the eye after YAG capsulotomy and according to this hypothesis, the rationale of the study is that as there would be no change in the refractive status of an eye after YAG capsulotomy, so there would be no need to refract the patient after YAG capsulotomy and patients can continue with the pre-YAG refraction. This would decrease the workload in the optometry department.

**Aims and Objectives:** To assess the effect of Nd: YAG laser posterior capsulotomy on the refractive status of the eye.

## Materials and Methods

After approval from the ethical review committee, the study was started (an approval letter has been sent to the editor). It was a Quasi-experimental study carried out in the outpatient department of Benazir Bhutto Hospital, Rawalpindi. The duration of the study was 6 months starting from 1<sup>st</sup> January 2017 to 30<sup>th</sup> June

2017. The sample size was calculated through the WHO calculator. The total number of patients was 95. Among these, 49 were females and 46 were males. Patients were selected based on non-randomized convenient sampling.

**Inclusion criteria:** Patients selected were those who had undergone uncomplicated cataract surgery with intraocular lens implantation 6 months or more than 6 months back and their posterior segment examination was unremarkable and they had no other associated eye illnesses like glaucoma, uveitis, corneal and retinal pathologies.

**Exclusion criteria:** Patients having glaucoma, uveitis, corneal pathologies, retinal pathologies, and those who don't have such ocular diseases but refused the consent, were not included in the study.

After taking informed consent from these patients, history and complete ocular examination including visual acuity, autorefractor reading taken with LIGHTMED SYL9000 Premi, best-corrected visual acuity, slit-lamp examination, dilated fundus examination were done

After examination, posterior capsulotomy was done using Nd: YAG laser. Post YAG capsulotomy picture is shown in figure 1. YAG machine was of company MR-3100 Premium Huvitz B/D 689-3. Gumjeong-dong, Gunposi Gyeonggi-do, 435-862.Korea.

Autorefractor readings were recorded after the procedure on the same day. After the procedure, topical anti-inflammatory and intraocular pressure-lowering agents were advised. Patients were examined again at week one and week four. At each visit, autorefractor reading and BCVA were recorded. As there was no change in refractive error at week 1 and week four, so we just analyzed the week four results for which week four results are shown in tabulated form in the result section. At each visit, autorefractor reading and BCVA were recorded. Readings at the end of 4 weeks were considered for the result purpose.

The results of the refraction were expressed as spherical equivalents. Data collected from proforma was entered in Statistical Package for the Social Sciences (SPSS) for the statistical analysis.

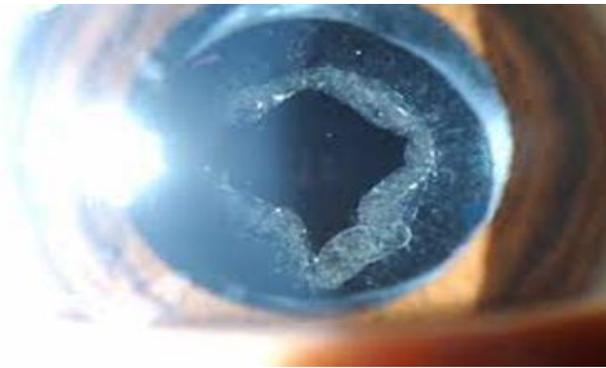


Figure 1: Yag capsulotomy hole

### Results

95 eyes of 95 patients were included in the study. 46 were males and 49 were females (Figure 2). The age of the patients ranged from 43 to 85 years. The mean age was 60.14 years with a standard deviation of 9.241.

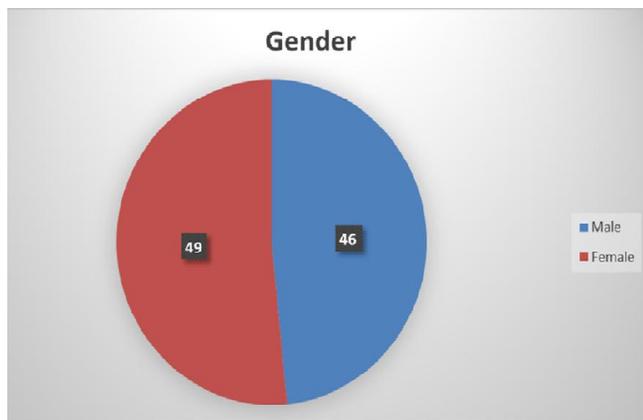


Figure 2: Gender distribution

Every patient had a specific type of refractive error. The distribution of refractive errors among these patients was noted as 51 Myopes, 24 Hypermetropes, and 20 Emmetropes (Table 1). Refractive errors distribution was like this:

Table 1: Distribution of refractive errors

Error type	Frequency	Percentage
Myopia	51	53.7
Hypermetropes	24	25.3
Emmetropes	20	21.1

To compare the spherical equivalent before and after YAG capsulotomy, Wilcoxon signed-rank test was applied to the mean of pre and post YAG spherical equivalents. There was statistically no significant difference between pre and post-YAG capsulotomy spherical equivalents with a P-value of 0.70 (Table 2).

According to our hypothesis, no change occurs in the refractive status of the eye after YAG capsulotomy, and analysis of our results shows that our hypothesis has been proven.

Table 2: Pre and Post YAG spherical equivalents with P-values

	Pre-YAG	Post-YAG	P-value
Hypermetropia	0.8750 (0.13 12.50)	0.8125 (-1.88 12.50)	0.444
Myopia	-2.1250 (-11.50 0.38)	-1.8750 (-11.50 1.00)	0.213
Emetropia	0.00 (0.00 0.00)	0.00 (-0.63 0.00)	.....
All	-0.50 (-11.50 12.50)	-0.6250 (-11.50 12.50)	0.70

- a) Results as median (range), Wilcoxon signed-rank test used to calculate the p-value.
- b) Only one case presented with a change in emmetropia.

### Discussion

Cataract surgery is associated with few acute and few delayed postoperative complications. One of the delayed complications of cataract surgery is posterior capsular opacification. Posterior capsular opacification is also known as “secondary cataract” or “after-cataract” which develops on the transparent posterior capsule in months or years’ time after uncomplicated cataract surgery. It develops due to abnormal growth and proliferation of the lens epithelial cells at the time of cataract surgery and later on these cells start migrating to the visual axis part of the posterior capsule, which results in gradual loss of vision.<sup>9</sup> When histological examination of the fibrous capsule was done, it was found that there is extracellular matrix accumulation and elongated myofibroblasts cells, which were positive for vimentin and alpha-smooth actine.<sup>10</sup>

In a study by Wu S, et al, the incidence of PCO was noted to be 11.8% at 1 year, 20.7% at 2 years post-cataract surgery, and 28.4% at 5 years of the surgery.<sup>(11)</sup> This complication is managed with Nd: YAG (1064nm) laser which has a photo disruptive property. This laser is applied to the posterior capsule to create a hole in the visual axis of the capsule and this posterior

capsulotomy then improves the visual acuity of the patient.<sup>11</sup>

In a study by Karahan E, et al, it was found that patients with larger capsulotomy have a myopic shift<sup>4</sup> which is contrary to our study but at the same time, studies of Paradhan C<sup>12</sup> and Sune M, et al<sup>13</sup> show that there is no change in refraction after posterior capsulotomy which is in accordance with our study.<sup>12,13</sup>

In a study of Elmagid A and Eldin MT, there was a significant hyperopic shift in patients with capsular phimosis syndrome but this study was different in this way that it was about the anterior capsule, and YAG laser was applied on phimosed anterior capsule which caused posterior movement of IOL resulting in a change in refractive power of eye.<sup>14</sup>

According to the study of Kim TG, Moon SW, in most cases Nd-YAG laser capsulotomy didn't change the refraction and only 7% of the eyes showed significant change in refraction.<sup>15</sup> Similarly in studies of Khambhaphant B and Kevher S, Nd: YAG laser posterior capsulotomy brought no change in spherical equivalents<sup>16,17</sup> but in a study of Sirakayaa E et al, a statistically significant change was noted in spherical equivalent after Nd-YAG posterior capsulotomy which is not supporting our study.<sup>18</sup> In the study of Oztas Z et al, changes were noted in anterior chamber depth, corneal thickness, and intraocular pressure but no change was noted in spherical equivalent.<sup>19</sup> Similarly the study of Monteiro T, et al showed that YAG laser posterior capsulotomy caused a significant change in IOL position but the refractive change after this laser was statistically insignificant.<sup>20</sup>

Another study, belonging to authors Nisar S, et al, showed immediate post Laser change in refractive error and so in spherical equivalent but later on, these changes became insignificant and this was the reason that they suggested delaying the spectacles' prescription in the immediate post-laser period.<sup>21</sup> Study of Ramachandra S et al also showed that spherical equivalent doesn't change after Nd: YAG laser posterior capsulotomy.<sup>22</sup>

Above discussed most of the studies are supporting our results that there is no significant change in spherical equivalent after Nd YAG laser capsulotomy. Our study had some limitations in that the sample size was small and it represents the results of only our hospital. This study should be carried out in other centers too so that we can combine the results and then make the final assessment about the results.

Secondly, short-term follow-ups were done. Results may change on long-term follow-ups.

Thirdly, we should also start doing analysis of accurate capsulotomy size in future studies and then should know the effect of capsulotomy size on spherical equivalent as some previous studies have shown a correlation of capsulotomy size and refraction readings.

## Conclusion

No significant change occurs in routine refraction of the patients following Nd: YAG laser capsulotomy. Keeping our results and the previous results in consideration, we can say that there is no need of doing new refraction of patients who undergo YAG capsulotomy and these patients can continue with their pre YAG capsulotomy glasses. By doing this we can reduce the major burden over the optometry department by avoiding post YAG refraction of these patients.

## References

1. IJ Sharon, LB Thomas, RB Chadwick, et al. Complications of cataract surgery. In: Lens and cataract. 11th sec. San Francisco: American Academy of Ophthalmology 2019; 183.
2. Kanski JJ, Bowling B. Lens. Clinical ophthalmology In: a systematic approach. 9th ed. Edinburgh: Elsevier Saunders; 2020.p331.
3. G, Chowdary NL. Sirisha Visual outcome of Nd-YAG laser capsulotomy in posterior capsule opacification. J. Evolution Med. Dent. Sci. April 2016; 5(29):1479-1482. DOI:10.14260/jemds/2016/348
4. Shetty NK, Sridhar S. Study of variation in intraocular pressure spike (IOP) following Nd YAG Laser capsulotomy. Journal of clinical and diagnostic research. 2016 Dec; 10(12). DOI:10.7860/JCDR/2016/21981.9037.
5. Yotsukura E, Torii H, Saiki M, Negishi K, Tsubota K. Effect of Neodymium: YAG Laser capsulotomy on visual function in patients with posterior capsular opacification and good visual acuity. J Cataract Refract Surg. 2016 March; 42(3):399-404. DOI: 10.1016/j.jcrs.2015.11.042.
6. Singh MD, Sharma N, Jain S. Anterior Segment Nd: YAG Laser Procedures: to Study intraocular pressure spikes and their prevention. Delhi Journal of Ophthalmology. 2015; 26(2):245-784. DOI:http://dx.doi.org/10.7869/djo.145
7. Verma N, Ahuja AK. Effect of neodymium: yttrium aluminum garnet laser posterior capsulotomy on intraocular pressure. Pan Am J Ophthalmol 2020; 2:6. DOI:10.4103/PAJO-26-19.
8. Akmaz B, Cakir A, Bayat AH, Kardas A. The effect of posterior capsulotomy size on refraction and anterior chamber parameters following Nd-YAG Laser treatment. Medicine Science International medical Journal. 2018; 7(3):571-574. DOI:10.5455/medscience.2017.07.8795
9. Uzel MM, Ozates S, Koc M, Uzel AGT. Decentration and tilt of intraocular lens after posterior capsulotomy. February 2018. Seminars in Ophthalmology;33(6):1-6. DOI: 10.1080/08820538.2018.1443146.
10. Shirai K, Saika S, Okada Y, Oda S, Ohnishi Y. Histology and immunohistochemistry of fibrous posterior capsule opacification

- in an infant. *Journal of Cataract and Refractive surgery*. 2004; 30(2): 523-526. DOI: 10.1016/S0886-3350(03)00616-3
11. Wu S, Tong N, Pan L, Jiang X. Retrospective analysis of potential risk factors for posterior capsular opacification after cataract surgery. August 2018. *Journal of Ophthalmology*. 2018(2):1-7. DOI: 10.1155/2018/9089285.
12. Parajuli A, Joshi P, Subedi P, Paradhan C. Effect of Nd: YAG Laser Posterior capsulotomy on intraocular pressure, Refraction, anterior chamber depth and macular thickness. *Clin Ophthalmol* 2019; 13:945-952. DOI: 10.2147/OPTH.S203677
13. Sune M, Roda V. The influence of size and shape of Nd: YAG capsulotomy on visual acuity and refraction. *International Medical Journal*. 2017; 4(1) 40-43. DOI: 08 January 2017.
14. Elmagid A, Eldin MT. Refractive changes after YAG laser anterior capsulotomy in capsular phimosis syndrome. *Journal of American Science* 2014; 10(8): 199-201. J. (ISSN: 1545-1003). DOI: <http://www.jofamericanscience.org>.
15. Kim TG, Moon SW. Hyperopic shift caused by capsule contraction syndrome after microincision foldable intraocular Lens implantation: case series. *BMC Ophthalmol* 19, 116 (2019). DOI: <https://doi.org/10.1186/s12886-019-1117-y>.
16. Khambhiphant B, Liumsirijarern C, Saehout P. The effect of Nd: YAG laser treatment of posterior capsule opacification on anterior chamber and refraction in pseudophakic eyes. *Clin Ophthalmol*. 2015; 9: 557-561. DOI: 10.2147/OPTH.S80220.
17. Cevher S, Kocluk Y, Cetinkaya S, Unal F, Cubuk Mehmet. Short-term effect of Nd-YAG laser capsulotomy on refraction, central macular thickness and retinal nerve fiber layer thickness. *Rev.Bras.Oftalmol*. 2017; 76(4): 186-189. <https://doi.org/10.5935/0034-7280.20170037>.
18. Sirakayaa E, Agaday A, Kucuk B, Hepokur M. Effect of Nd-YAG laser capsulotomy on refraction and anterior segment parameters in patients with posterior capsular opacification. *Erciyes Med J* 2019; 41(3): 316-20. DOI: <https://www.researchgate.net/publication/349882938>.
19. Oztas Z, Palamar M, Afrashi F, Yagci A. The effects of Nd:YAG laser capsulotomy on anterior segment parameters in patients with posterior capsular opacification. *Clin Exp Optom* 2015; 98: 168-171.
20. Monteiro T, Soares A, Leite RD, Franqueira N, Faria-Correia F, Vaz F. Comparative study of induced changes in effective lens position and refraction after Nd: YAG laser capsulotomy according to intraocular lens design. *Clinical Ophthalmology* 2018; 12: 533-537. DOI: 10.2147/OPTH.S156703. eCollection 2018.
21. Nisar S, Rehman D, Rehman A. Effect of Nd-Laser posterior capsulotomy on the anterior chamber depth. *Pak J Physiol* 2019; 15(1): 13-15. <https://pjp.pps.org.pk/index.php/PJP/article/view/1075>
22. Ramachandra S, Kuriakose F. Study of early refractive changes following Nd: YAG capsulotomy for posterior capsule opacification in pseudophakia. *Indian journal of clinical and experimental Ophthalmology*. 2016; 2(3): 221-226. Online access: 2395-1451