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ORIGINAL ARTICLE

Intraocular Pressure and its Variation with Total Amount of Energy used Following Nd: YAG Capsulotomy in Pseudophakic

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ABSTRACT

Purpose: The objective of the study was how Nd: YAG laser capsulotomy affected IOP and how it changed with the amount of energy utilised.

Methods: A prospective, multi ccentered study was conducted between September 2021 to February 2022 in Ophthalmology Department departments. Total of sixty pseudophakic eyes of both genders, age ranging between 40 to 60 years with significant posterior capsular opacity following uncomplicated cataract surgery were included through non-probability purposive sampling technique. Inflammation, ocular malignancies, posterior segment disease, and systemic disease participants were all ruled excluded. After detailed history and ocular examination, Nd: YAG laser posterior capsulotomy was done. Patients were divided into two groups on the basis of total amount of laser energy used was noted as high energy (>50mJ) and low energy (<50mJ) and then post-laser IOP after one hour and 24 hours measured. Data was analyzed by using SPSS through repeated measure ANOVA for comparison of quantitative variables.

Results: Best corrected visual acuity after Nd: YAG capsulotomy improved significantly (P=0.001). Pre-laser IOP was 14.01± 2.95 mmHg. Mean high energy was 76mJ and low energy 40mJ. Elevated IOP was seen in 55 patients, significantly increase in IOP after 1 hour in both groups (P=0.000). After 24hours IOP change was significantly higher in high energy group (p=0.033) than in low energy. Post-laser IOP after 1 hour in high energy group was 21.89±4.59 mmHg and in low energy group 16.79±2.89 mmHg. IOP after 24hour in high energy group was 19.89± 3.05 mmHg and in low energy group 14.98±1.79 mmHg.

Conclusions: After Nd: YAG laser capsulotomy, there is a considerable increase in IOP, which varies depending on the overall amount of energy used. Greater the amount of Nd-YAG energy has significantly higher chances of raising IOP. Hence, it was suggested that each patient after Nd: YAG capsulotomy must monitored for IOP variation.

Keywords: Intraocular pressure, Nd: YAG capsulotomy, Energy level, Posterior capsular opacity, Visual acuity

INTRODUCTION

After cataract surgery with posterior chamber intraocular lens implantation most frequent complication is posterior capsular opacity (PCO) [1].

According to research, the global incidence of PCO after two years after cataract surgery ranges from 7% to 31% [2]. Elsching's pearls, wrinkling, and epithelial fibrosis are manifestations of PCO. The central opening of the posterior capsule can be performed surgically or with a laser, which is a convenient and non-invasive method that eliminates the need for surgery [3]. Reduced visual acuity, poor contrast sensitivity, glare disability, and monocular diplopia are common visual problems associated with PCO, which are frequently managed [4,5].

Modern cataract surgery generated capsular bag that comprehend anterior and posterior capsule. Passage of free light along the visual axis through transparent intraocular lens and thin acellular posterior Reduced visual acuity, poor contrast sensitivity, glare disability, and monocular diplopia are common visual problems associated with PCO, which are frequently managed. capsule permitted by capsular bag. Despite the rigorous surgical trauma, lens epithelium permanently resident on remaining anterior capsule. These resilient group of cells recolonized the anterior and cell free posterior capsule which ultimately encroach the visual axis that has been changed the cell matrix and organization that scatter the light [6].

Standard treatment which has success rate more than 95% that is currently used for PCO is Nd: YAG laser capsulotomy [7]. Laser capsulotomy uses to apply series of focal ablation of Nd: YAG laser in posterior capsule to create the central circular opening in the visual axis [8]. To treat the PCO Nd: YAG has been used for 20years [9]. Although this procedure has been found safe and effective but events such as retinal detachment [10-12], cystoid macular oedema [11,13] and rise in intraocular pressure [14,15] tend to occur following Nd: YAG capsulotomy.

The increase in intraocular pressure following Nd: YAG capsulotomy is caused by debris deposition in the trabecular meshwork, trabeculitis caused by radiating shock waves, neovascular mechanism, pupillary block, and inflammatory swelling of the ciliary body or iris root associated with angle closure [16].

The present study was an endeavored to evaluate the influence of Nd: YAG laser capsulotomy on IOP and its variation with energy used.

METHODOLOGY

A prospective, multicentered study was conducted in Ophthalmology Departments from September 2021 to February 2022. Data was collected through non-probability purposive sampling technique.

A total of 60 pseudophakic eyes of 60 subjects of both genders (male and female), age ranging between 40 to 60 years with significant posterior capsular opacity and best corrected visual acuity (BCVA) ≤6/12 were included. All of the patients undergone simple cataract surgery with posterior chamber intraocular lens implantation (PCIOL). Pre-laser intraocular pressure (IOP) was between 10 and 20 mmHg in all of subjects. Exclusion criteria included patient with antiglaucoma medication, inflammatory eye disease, corneal diseases, optic neuropathy, diabetic retinopathy, maculopathy and systemic diseases. Those who had undergone anterior and posterior segment ophthalmic surgeries were excluded from the study.

All patients got a thorough history and ocular examination before to Nd: YAG posterior capsulotomy, which included best corrected visual acuity (BCVA), slit lamp bimicroscopy, and automated applanation tonometry. A projection-type Snellen chart was used to estimate BCVA. Slit lamp biomicroscopy was performed to access the posterior capsular opacity (PCO) and for detailed fundus examination to rule out the ocular pathologies. Intraocular pressure (IOP) was measured with automated applanation tonometry prior to Nd: YAG capsulotomy for baseline IOP measurement.

Prior to procedure pupil dilation was done with administration of 1% tropicamide eye drops. Pre-laser and post-laser after 24hours IOP were measured nondilated eyes. While post-laser after one hours was taken from dilated eyes. Before applying the capsulotomy contact lens (ABRAHAM CAPS YAG LENS) topical anesthesia proparacaine hydrochloride 0.5% eye drops was administered. Minimum pulse of Nd: YAG laser was used with energy level 1.0mJ/pulse.

Nd: YAG laser posterior capsulotomy procedure was done by using Nd: YAG laser LIGHTMED Corporation model laser PULSA 9000 PREMIO USA. To make the opening of 4mm central visual axis in posterior capsule. Total amount of energy used to clear the visual axis was noted from Nd: YAG laser machine control display panel. Total amount of energy level divided into two groups on the basis of laser energy used was noted as high energy (>50mJ) and low energy (<50mJ). Post-laser IOP after one hour and 24 hours measured. After the procedure, topical nepafenac eye drops prescribed for thrice a day for one week.

For data analysis, the Statistical Package for Social Sciences software (SPSS version 22.0) was implemented. Demographic data included gender and age group was represented by mean ± Standard deviation (SD). Best corrected visual acuity before and after Nd-YAG capsulotomy and energy used was in frequencies and percentage. Repeated measure ANOVA was used for comparison of quantitative variables (pre-laser and post-laser after one hour and 24 hours IOP variation with Nd: YAG posterior capsulotomy energy used). P value ≤ 0.05 was considered as statistically significant.

RESULTS

Sixty patients underwent Nd: YAG posterior capsulotomy of unilateral eyes. 36 (60%) were male and 24 (40%) were female in present study (Figure 1). Age of the patient were between 40 to 60years (mean age of 51.6 ± 4.35) (Figure 2). Mean age and gender were not statistically significant between high energy and low energy groups.

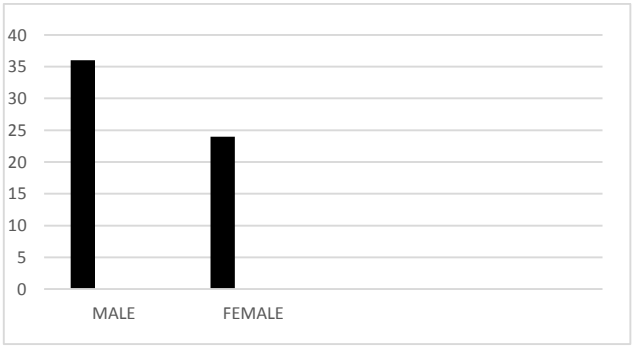

Figure 1: Demographic data

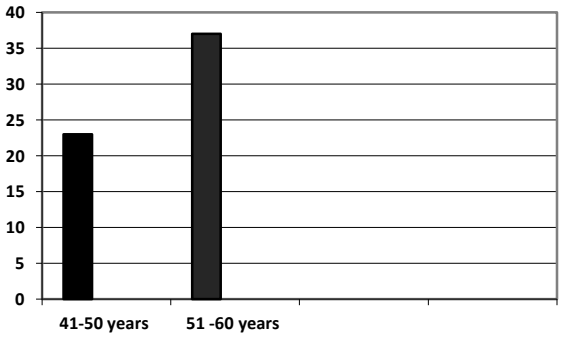

Figure 2: Age distribution

Mean duration from surgery was 2.45 ± 1.89 years. Best corrected visual acuity (BCVA) after Nd: YAG capsulotomy improved significantly. (Table 1)

Table 1: Best corrected visual acuity pre-laser and post-laser

Visual acuity	Pre-laser (n=60) (%)	Post-laser (n=60) (%)	P value
>6/60	25 (41.66)	59 (98.33)	0.000
<6/60	35 (58.33)	1 (1.66)	0.001

Mean high energy used for Nd: YAG capsulotomy was 76mJ and low energy was 40mJ. (Table 2)

Table 2: Mean energy used for high energy and low energy groups

	High (>50mJ)	Low (<50mJ)
Total amount of energy used	76 ± 1.45mJ	40 ± 2.25mJ

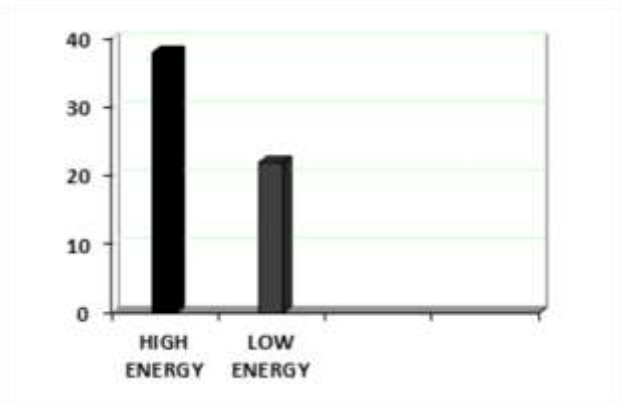

Figure 3: Total energy expended on posterior capsulotomy with Nd: YAG

In present study high energy group comprises 38 while low energy group 22 patients. (Figure 3)

Pre-laser IOP was 14.01± 2.95 mmHg. Elevated IOP was seen in 55 (91.66%) out of 60 patients. (Table 3)

Table 3: Post-laser IOP variation after 1 hour and 24 hours

Time interval	IOP No raise n (%)	IOP raise 1-5 mmHg n (%)	IOP raise >5 mmHg n (%)
Post-laser after one hours	5 (8.33)	37 (61.66)	18 (30.0)
Post-laser after 24 hours	9 (15)	41 (68.33)	10 (16.66)

IOP increased significantly in both groups after one hour (P=0.000) (Table 4). IOP change was considerably higher in the high energy group (p=0.033) than in the low energy group after 24 hours. Post-laser IOP after one hour in high energy group was 21.89±4.59 mmHg and in low energy group 16.79±2.89 mmHg. IOP after 24hour in high energy group was 19.89± 3.05 mmHg and in low energy group 14.98±1.79 mmHg. IOP increase of which 80% of those with high energy group.

Table 4: Pre-laser and Post-laser after one hour and 24 hours compared with energy used for Nd: YAG posterior capsulotomy

IOP measurement	Nd: YAG posterior capsulotomy energy used		P value
	High energy	Low energy	
Pre-laser	14.01± 2.95	13.01± 1.05	0.510
Post-laser after 1hour	21.89±4.59	16.79±2.89	0.000
Post-laser after 24hours	19.89± 3.05	14.98±1.79	0.033

Post-laser IOP elevation after one hour was 7.88 ± 1.64 mmHg and after 24hours was 5.88 ± 0.1 mmHg in high energy group was statistically significant. Post-laser IOP variation in low

energy group was after one hour 3.78 ± 1.84 mmHg and after 24hours was 3.78 ± 0.75 mmHg.

DISCUSSION

Major concern of PCO is decreased vision, it also caused glare, impaired contrast sensitivity. Most effective treatment of PCO is Nd: YAG posterior capsulotomy. Breakdown of capsular done by infrared light 1064nm followed by pressure wave created which is amplified and focused to formed energy plasma so electrons are ripped away from nuclei and corresponding shock waves [17]. In present study total subjects underwent Nd: YAG posterior capsulotomy was 60. Out of which 36 were male and 24 were female. Age group was between 40 to 60years. It is the most common age group that underwent cataract surgery. Shetty and Sridhar [18] observed a similar trend, including 60 % males and 40 % females, and 68.6% of the patients studied were between the ages of 50 and 70.

Posterior capsular opacity is the most common delayed consequence following cataract surgery. According to Fong et al., [19] more than a third of elderly people in a large cataract surgical cohort developed primarily moderate PCO within three years postoperative phacoemulsification surgery..

In general practice when evaluating patient visual status in relation to any procedure, our main concern is visual acuity. All patients with complaint of decreased vision underwent the procedure. In present study after Nd: YAG capsulotomy, 98.33% showed improvement of visual acuity. Similar findings were reported by Cheng et al., [20] improvement of visual acuity after the capsulotomy. In present study, no improvement of visual acuity was about 1.66% patient. That may be associated with any fundus abnormality which remains undetected due to dense fibrous posterior capsule opacity.

Increased in IOP after Nd: YAG posterior capsulotomy is most common complication. In present study elevated IOP was seen in 55 (91.66%) patients out of 60. Mohammed YK et al., [21] reported IOP elevation in 84% cases in their study. Ari et al., [22] increased IOP after Nd:YAG laser capsulotomy, but when the total energy level is less than 80 mJ, the severity and duration are reduced. which is comparable to present study.

In present study pre-laser IOP was 14.01± 2.95 mmHg. Post-laser IOP after one hour in high energy group was 21.89±4.59 mmHg and in low energy group 16.79±2.89 mmHg. IOP after 24hour in high energy group was 19.89± 3.05 mmHg and in low energy group 14.98±1.79 mmHg. Post-laser IOP elevation after one hour was 7.88 ± 1.64 mmHg and after 24hours was 5.88 ± 0.1 mmHg in high energy group. Post-laser IOP variation in low energy group was after one hour 3.78 ± 1.84 mmHg and after 24hours was 3.78 ± 0.75 mmHg. The pre-laser mean IOP was 14.45 2.52 mmHg, which increased to 16.08 ± 3.69 mmHg after 1 hour and peaked at 16.83 ± 3.69 mmHg by 2 hours after the laser capsulotomy procedure, as per Kaur et al., [17] study results.

Muhammed Waseem et al., [2] reported in study low energy group comprises less than 50mJ with mean energy 36.46± 6.42mJ and high energy group more than 50mJ with mean energy 56.2.65± 2.65mJ. They found elevation in pressure about 5.51 ± 1.58 in high energy group while 3.83± 1.84 in low energy group which is also in concordance with present study.

In present study IOP elevation is associated 80% with high energy group. Verma et al., [23] found that raised in IOP associated with high laser energy was used during the procedure of Nd: YAG posterior capsulotomy. They discovered that the mean rise in IOP was modest for cases involving less than 40 mJ total energy and highest for cases involving more than 80 mJ total energy. Their study reported a significant link between a high-energy group and an increase in IOP. This aspect justifies the results of present study. However, the process is unknown. One possibility is that the more energy utilized during the procedure (Nd: YAG capsulotomy), the more particle liberated from posterior capsular opacity breakdown and acute inflammatory cells, which occluded the angle of anterior chamber, causing impeded outflow and raising IOP.

CONCLUSION

Intraocular pressure rise is a frequent complication of Nd: YAG posterior capsulotomy, which is otherwise a smooth and reliable treatment for posterior capsular opacification. BCVA significantly improved after the procedure. Severity of IOP variation depends upon the total amount of energy used to clear central visual axis. Greater the total amount of energy used, more the chance of increase of IOP and lesser the chance of IOP decrease. As a result, it was suggested that after Nd: YAG posterior capsulotomy, each patient's IOP be monitored.

Recommendation of this study is to individualize each patient in which Nd: YAG posterior capsulotomy performed is needed to optimize the effectiveness of treatment in each case. If there is significant rise of IOP antiglaucoma medication should be prescribed accordingly. If there is minimal rise of IOP is as in low energy group antiglaucoma medication can be avoided.

REFERENCES

1. Karahan E, Er D, Kaynak S. An overview of Nd: YAG laser capsulotomy. Medical hypothesis, discovery and innovation in ophthalmology. 2014;3(2):45.
2. Waseem M, Khan HA. Association of raised intraocular pressure and its correlation to the energy used with raised versus normal intraocular pressure following Nd: YAG laser posterior capsulotomy in pseudophakes. J Coll Physicians Surg Pak. 2010;20(8):524-7.
3. Khanzada MA, Jatoi SM, Narsani AK, Dabir SA, Gul S. Is the Nd: YAG laser a safe procedure for posterior capsulotomy?. Pakistan Journal of Ophthalmology. 2008;24(2).
4. Dharmaraju B, Vijayasree S, Sridhar K. A clinical study of visual outcome in Nd: YAG laser capsulotomy in posterior capsular opacity. International Journal of Contemporary Medical Research. 2016;3(9).
5. MukheRji R, SuNe P. Contrast Sensitivity and Visual Acuity Before and After Nd: YAG Capsulotomy in Patients with Posterior Capsular Opacification: A Prospective Study. Journal of Clinical & Diagnostic Research. 2020;14(3).
6. Wormstone IM, Wang L, Liu CS. Posterior capsule opacification. Experimental eye research. 2009;88(2):257-69.
7. Pandey SK, Apple DJ, Werner L, Maloof AJ, MBiomed E, Milverton EJ. Posterior capsule opacification: a review of the aetiopathogenesis, experimental and clinical studies and factors for prevention. Indian journal of ophthalmology. 2004;52(2):99-112.
8. Cetinkaya S, Cetinkaya YF, Yener HI, Dadaci Z, Ozcimen M, Acir NO. The influence of size and shape of Nd: YAG capsulotomy on visual acuity and refraction. Arquivos brasileiros de oftalmologia. 2015;78:220-3.
9. Hu C-Y, Woung L-C, Wang M-C. Change in the area of laser posterior capsulotomy: 3 month follow-up. Journal of Cataract & Refractive Surgery. 2001;27(4):537-42.
10. Gore VS. The study of complications of Nd: YAG laser capsulotomy. International journal of bioinformatics research. 2012;4(2):265.
11. Khan B, Alam M, Shah MA, Bashir B, Iqbal A, Alam A. Complications of Nd: YAG laser capsulotomy. Pakistan Journal of Ophthalmology. 2014;30(3).
12. Wesolosky JD, Tennant M, Rudnisky CJ. Rate of retinal tear and detachment after neodymium: YAG capsulotomy. Journal of Cataract & Refractive Surgery. 2017;43(7):923-8.
13. Lee MS, Lass JH. Rapid response of cystoid macular edema related to Nd: YAG laser capsulotomy to 0.5% ketorolac. 2004:162-4.
14. Awan AA, Kazmi SH, Bukhari SA. Intraocular pressure changes after Nd-YAG laser capsulotomy. Journal of Ayub Medical College Abbottabad. 2001;13(2):3-4.
15. Ge J, Wand M, Chiang R, Paranhos A, Shields MB. Long-term effect of Nd: YAG laser posterior capsulotomy on intraocular pressure. Archives of ophthalmology. 2000;118(10):1334-7.
16. Hassan HT. Changes in Intraocular Pressure after Nd-YAG Laser Posterior Capsulotomy. Int J Clin Exp Ophthalmol. 2020;4:021-30.
17. Kaur P, Gusain P, Mohan C, Bedi J. Effect of Nd: YAG laser capsulotomy on IOP rise and its variation with energy used. Ind J Clin Exp Ophthalmol. 2018;4:396-400.
18. Shetty NK, Sridhar S. Study of variation in intraocular pressure spike (IOP) following Nd-YAG laser capsulotomy. Journal of clinical and diagnostic research: JCDR. 2016;10(12):NC09.
19. Fong CS, Mitchell P, Rochtchina E, Cugati S, Hong T, Wang JJ. Three-year incidence and factors associated with posterior capsule opacification after cataract surgery: The Australian Prospective Cataract Surgery and Age-related Macular Degeneration Study. American journal of ophthalmology. 2014;157(1):171-9.
20. Cheng CY, Yen MY, Chen SJ, Kao SC, Hsu WM, Liu JH. Visual acuity and contrast sensitivity in different types of posterior capsule opacification. Journal of Cataract & Refractive Surgery. 2001;27(7):1055-60.
21. Khan MY, Jan S, Khan MN, Khan S, Kundi N. Visual outcome after Nd-YAG capsulotomy in posterior capsule opacification. Pakistan Journal of Ophthalmology. 2006;22(02).
22. Ari S, Cingü AK, Sahin A, Çinar Y, Çaça I. The effects of Nd: YAG laser posterior capsulotomy on macular thickness, intraocular pressure, and visual acuity. Ophthalmic Surgery, Lasers and Imaging Retina. 2012;43(5):395-400.
23. Verma N, Ahuja AK. Effect of neodymium: yttrium aluminum garnet laser posterior capsulotomy on intraocular pressure. The Pan-American Journal of Ophthalmology. 2020;2(1):6.