Al-Azhar International Medical Journal

Volume 4 | Issue 11 Article 21

2023
Section: Ophthalmology

Comparison Of Macular Thickness Changes After Neodymium: Yttrium–Aluminum–Garnet Laser Capsulotomy In Diabetic And Non-Diabetic Patients

Sayed Abbas Sayed
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt

Hatem Mahmoud Samy Abedelkawy
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt

Mostafa Saad Sayed Kamel
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt, drmostafasaad091@gmail.com

How to Cite This Article

Sayed, Sayed Abbas; Abedelkawy, Hatem Mahmoud Samy; and Kamel, Mostafa Saad Sayed (2023) "Comparison Of Macular Thickness Changes After Neodymium: Yttrium–Aluminum–Garnet Laser Capsulotomy In Diabetic And Non-Diabetic Patients," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 11, Article 21.
DOI: https://doi.org/10.58675/2682-339X.2105

ORIGINAL ARTICLE

Comparison of Macular Thickness Changes After Neodymium: Yttrium−aluminum−garnet Laser Capsulotomy in Diabetic and Nondiabetic Patients

Sayed Abbas Sayed, Hatem Mahmoud Samy Abedelkawy, Mostafa Saad Sayed Kamel*

Department of Ophthalmology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: **Commonly delayed complications after cataract surgery include posterior capsule opacification (PCO) following cataract removal. The PCO is typically treated with neodymium: yttrium−aluminum−capsulotomy using a Garnet Nd: YAG laser. It is an effective, noninvasive simple, fast, and relatively safe outpatient surgery for managing intact PCO following surgery.**

Objectives: **To compare thickness variations in the central macula thickness (CMT) after ND: YAG laser posterior capsulotomy in diabetic with nondiabetic patients.**

Patients and methods: **A prospective interventional comparative research was performed in Ophthalmology Department of Al-Azhar University Hospitals during the period from September 2021 to July 2022. The investigation included 40 posterior capsule-opacified eyes from 40 patients. Separated into two categories, group I included diabetic patients and group II included nondiabetics.**

Conclusion: **Capsulotomy using Nd: YAG laser is the standard procedure for PCO. In both diabetic and nondiabetic patients, there was an increase in CMT. Despite the lack of a clinical manifestation, optical coherence tomography follow-up showed no difference between nondiabetic and controlled diabetics for these alterations. No correlation was established among the total Nd: YAG laser energy and the rise in CMT. Diabetic patients saw a greater escalation in CMT following Nd: YAG laser capsulotomy.**

Keywords: Diabetes, Macular thickness, Neodymium: yttrium−aluminum garnet laser capsulotomy

1. Introduction

A common and distressing consequence following cataract extraction is posterior capsule opacification (PCO). Proliferation of remaining lens epithelial cells following cataract surgery causes PCO. This is because it is impossible to completely eliminate posterior capsule epithelial cells on cataract surgery.[1]

Despite the fact that many surgeons have the clinical impression that post-cataract surgery PCO in diabetic patients is more extensive than in nondiabetic patients, this is still debatable. The recommended treatment for two ND is YAG laser capsulotomy. In a brief period of time, YAG laser can be performed easily. However, post-ND: there have been reports of intraocular lens dislocation and injury, cystoid macular edema (CME), and retinal detachment following YAG laser capsulotomy.[2]

Increased intraocular pressure (IOP) is an exceedingly prevalent adverse effect after YAG laser posterior capsulotomy. Angle closure was ascribed to debris accumulation in the trabecular meshwork, pupillary obstruction, and inflammation-induced ciliary body or iris root swelling.[3]

A total energy level of less than 80 mJ reduces the severity and duration of elevated IOP and macular thickness, according to Ari et al.[4] It is unclear what impact capsulotomy magnitude on IOP and macular thickness when consistent energy levels are used for Nd: YAG laser capsulotomy.

Accepted 26 June 2023.
Available online 24 January 2024

* Corresponding author.
E-mail address: drmostafasaad091@gmail.com (M.S.S. Kamel).

https://doi.org/10.58675/2682-339X.2105

Nowadays Nd: YAG laser capsulotomy is often conducted for PCO patients. Most cases of impaired vision can be attributed to CME. Following capsulotomy, when CME persists over time, it damages the macular structure irreparably, leading to a loss of vision.

The incidence of macular edema following Nd: YAG laser capsulotomy ranges from 0 to 4.3 %. Optical coherence tomography (OCT) is more accurate than fundus fluorescein angiography (FA) and biomicroscopic examination in detecting macular edema.[5,6]

This research aimed to compare thickness variations in the central macula thickness (CMT) after Nd: YAG laser posterior capsulotomy in diabetic with nondiabetic patients.

2. Patients and methods

In this prospective, randomized, controlled interventional trial, 40 eyes from 40 individuals with opacification of the posterior capsule were analyzed. There were a total of 40 eyeballs in group I (20 from 20 diabetic individuals and 20 from 20 nondiabetic patients). The research was conducted in the Ophthalmology Departments of Al-Azhar University institutions between September 2021 and July 2022.

2.1. Inclusion criteria

Patients with posterior capsular opacification after phacoemulsification without complications, cataract extraction done after more than 6 months.

2.2. Exclusion criteria

On OCT before surgery, the presence of any macular disease, including edema, scarring, and epiretinal membrane. Patients with prior intraocular inflammation (uveitis) media opacity interfering with preoperative evaluation, including dense PCO and patients with glycosylated hemoglobin (HbA1C) greater than 7 (uncontrolled diabetes mellitus).

2.3. Evaluation before the procedure

History taking (age and sex, 'onset, course and duration of diminution of after cataract surgery,' history of systemic diseases as diabetes and hypertension and associated ocular diseases), ocular examination [best-corrected visual acuity (BCVA)], were evaluated, pupillary reaction, refraction using automated refractometer, IOP measurement by Goldman applanation tonometer, slit lamp examination, and fundus examination.

2.4. Preoperative investigation

HbA1C for all patients and OCT by Topcon 3D 2000 swept source OCT for evaluation of the macula (Fig. 1).

2.5. Technique of the YAG laser posterior capsulotomy[7]

Explain the procedure: the patient is detailed about purpose of the procedure, duration, painless nature and importance of maintenance of steady fixation. He may hear small clicking noise produced by the acoustic waves generated. Informed consent: should be obtained prior to the procedure. Pupillary dilation (mydriasis): full mydriasis was obtained with topical tropicamide 1 % and phenylephrine hydrochloride 2.5 %. Anesthesia: topical anesthesia was then achieved using benoxinate hydrochloride 0.5 % eye drops. Steady fixation: obtained by: (use of head strap to counter patients' tendency to pull back his/her head during the procedure, suitably adjusting illuminated target). Contact lens: a contact laser lens with lubricating gel (methyl cellulose) was used during the capsulotomy. Room illumination: the laser room should be darkened/semidarkened to improve surgeon's of the target and consequent accurate focusing of laser beam. Slit-lamp beam: it should be narrow and obliquely angled. This acts as an indicator for size of the pupil in ambient light situation. Oculars of the slit-lamp should be adjusted prior to laser session. The slit-lamp beam and the aiming beam are adjusted to become parafocal in order to obtain maximum benefit.

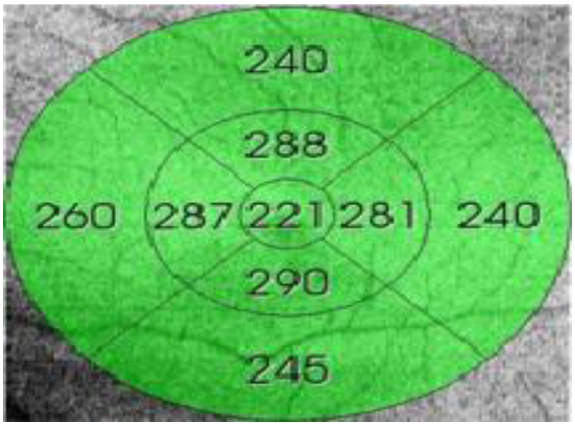

Fig. 1. Retinal map analysis show normal macula and distribution of its thickness in the form of a colored map.

Capsulotomy technique: In this study we use an average 3.2 ± 0.5 mJ per pulse from Q-switched Nd: YAG laser which was sufficient to open posterior capsule. The energy setting per pulse may be increased in recalcitrant thick posterior capsules.

2.6. Pattern of capsulotomy opening

2.6.1. Cruciate opening

It is made by moving from 12 o'clock to 6 o'clock in order to make it. Next, go laterally from the first vertical opening's center margins towards the three and nine o'clock positions to complete the cruciate opening. If residual posterior capsular flaps are still present, they are cut with laser beams and then retract and fall back towards the periphery. Because they might make contact with the corneal endothelium or the angle of the anterior chamber, we try to avoid making big fragments. In the future, this will lead to corneal decompensation. The goal is to create flaps that are inferiorly and peripherally based.

2.6.2. Postprocedure medications

After laser treatment, all patients were instructed to apply 1 % topical prednisolone acetate four times daily and 0.2 % brimonidine tartrate twice daily.

2.6.3. Follow-up schedule

Schedule follow-up visits in the first month, and the third month after the procedure.

Ophthalmic examinations were performed on all patients, which included: HbA1C following 3 months, BCVA, slit-lamp examination, IOP, fundus examination, OCT (post first and third months), and fundus examination.

2.6.4. Ethical consideration

The study was given the green light by the medical ethics council at Al-Azhar University. After having their concerns addressed and questions answered, all participants signed an informed consent form before any research could begin.

2.7. Statistical analysis

IBM's SPSS 28.0 (IBM, Armonk, New York, USA) statistical package software was used to analyze the data. For grouped information, we provide the mean ± SD, as well as the minimum and maximum values, the total number, and the percentage breakdown. The statistical significance of the differences between the independent variables was examined using Student's *t*-test. Within each group, we compared the pretreatment and posttreatment means using paired *t* tests. The *P* value was less than 0.05, indicating significance in statistics.

3. Results

Table 1 shows that the there was no significance between the studied groups regarding age, sex, and laterality.

Table 2 shows that there is no discernible variation in Log MAR BCVA in either group preoperatively or at first and third months after laser.

Table 3 shows a statistically significant difference in the change of BCVA (improvement) when comparing prelaser with postlaser at 1 and 3 months after initial treatment in both groups (Fig. 2).

Table 4 shows increase in IOP after laser at first and third month in both groups, these changes are statistically significant in both groups. The increments are lowered at the third month postlaser in both groups (Fig. 3).

Table 5 shows statistically significant difference in CMT when comparing preoperative measures to that at first and third month in both groups. There is increase in CMT first month and third month after laser in both groups but the increments after third month is lesser in both groups (Fig. 4).

4. Discussion

After cataract removal, PCO is the most common delayed consequence. The standard treatment for PCO is Nd: capsule lysis via YAG laser.[7]

Noninvasive, effective, and done as an outpatient operation, posterior capsulotomy with Nd: YAG laser is advantageous.[8]

This technique is effective, but it has a number of complications, including an increase in IOP, intraocular lens injury and dislocation, iridocyclitis, vitreous hemorrhage and vitritis, retinal detachment, macular edema, and refraction change.[9]

Inflammation of the retina and choroid can lead to CME after intraocular surgery. After Nd-YAG

Table 1. Participants' basic features.

	Group I ($N = 20$)	Group II ($N = 20$)	*P* value
Age (year)			
Mean ± SD	64.9 ± 7.2	59.5 ± 9.7	0.051
Range	46–75	42–74	
	n (%)	*n* (%)	
Sex			
Male	12 (60)	9 (45)	0.342
Female	8 (40)	11 (55)	
Laterality			
Right	8 (40)	11 (55)	0.342
Left	12 (60)	9 (45)	

Table 2. The mean log MAR best-corrected visual acuity prelaser and first month and third month postlaser among both groups.

Variables	Group I ($N = 20$) (mean ± SD)	Group II ($N = 20$) (mean ± SD)	P value
Pre-BCVA	0.555 ± 0.157	0.650 ± 0.147	0.701
1 month postlaser	0.180 ± 0.115	0.305 ± 0.167	0.080
3 months postlaser	0.160 ± 0.099	0.300 ± 0.169	0.064

BCVA, best-corrected visual acuity.

posterior capsulotomy, CME has been documented to occur in 0–4.3 % of instances, depending on the study.[10]

Mayuri and Gautam,[11] who studied 100 eyes from 100 patients. They reported that there was no significance between the studied groups regard of age, sex, and laterality.

Visual acuity significantly increased in both groups statistically when comparing pre laser values with first and third month postlaser. There were no statistical differences between both groups at prelaser and at first month and third month postlaser. As BCVA and CMT exhibited no statistically significant variance between both groups, this means the increased in CMT had no significant effect on visual acuity and no difference in increase of CMT in diabetic and nondiabetic. In other word there was no difference in the effect of ND-YAG laser between controlled diabetic and nondiabetic patients.

With respect to IOP, the present study found that after laser treatment, the mean IOP in both groups was considerably higher than preoperative levels. The rise in IOP was lowered at third month than at first month but still statistically significantly higher than prelaser measurements (slightly higher than preoperative values but within normal limit). The result of the present study is similar to that of Bhargava et al.,[12] Ari et al.,[4] Patel et al.,[13] and Burq and Taqui.[14]

Table 3. The changes in mean best-corrected visual acuity pre–post laser among both groups.

Variables	Group I ($N = 20$)	Group II ($N = 20$)
Pre-BCVA–post 1 month		
Mean ± SD	0.375 ± 0.15	0.345 ± 0.19
t-test	11.05	8.22
P value	0.000	0.000
Pre-BCVA–post 3 months		
Mean ± SD	0.395 ± 0.15	0.350 ± 0.19
t-test	11.48	8.33
P value	0.000	0.000

BCVA, best-corrected visual acuity.

Table 4. The mean intraocular pressure changes pre–post laser among both groups.

Variables	Group I ($N = 20$) (mean ± SD)	Group II ($N = 20$) (mean ± SD)
Pre IOP–post 1 month	5 .60 ± 2.26	6.50 ± 2.24
t-test	11.1	13.0
P value	0.000	0.000
Pre IOP–post 3 months	1.75 ± 1.77	1.85 ± 1.53
t-test	4.41	5.40
P value	<0.0001	<0.0001

IOP, intraocular pressure.

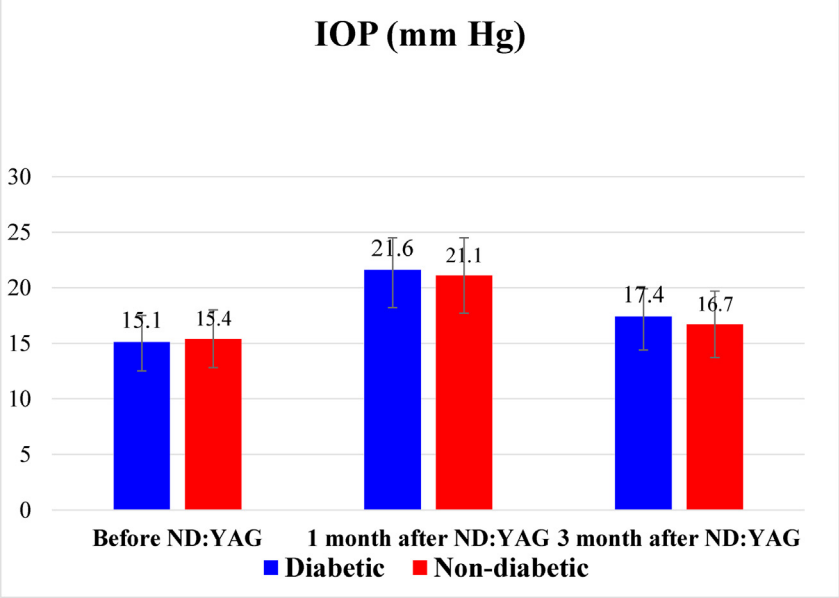

Fig. 2. Comparison between the two studied groups group I (diabetics) and group II (nondiabetics) according to IOP preoperatively and first month and third month postlaser.

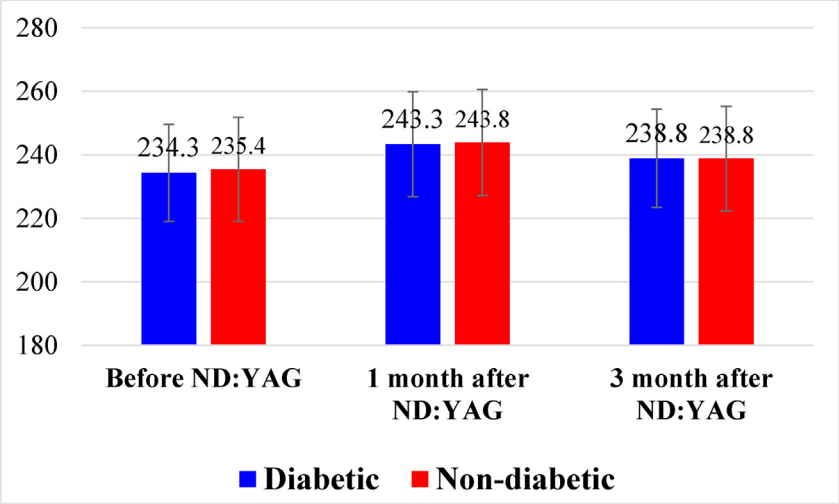

Fig. 3. Mean CMT among studied groups preoperatively and first month and third month postlaser. CMT, central macula thickness.

Table 5. The mean central macula thickness pre–post laser among both groups.

Variables	Group I ($N = 20$)	Group II ($N = 20$)
Pre CMT–post 1 month		
Mean ± SD	8.35 ± 4.43	13.53 ± 11.48
t-test	8.43	5.14
P value	0.000	0.000
Pre CMT–post 3 months		
Mean ± SD	4.30 ± 2.54	3.37 ± 1.46
t-test	7.58	10.05
P value	0.0001	0.0001

CMT, central macula thickness.

Contrary to the present study following ND-YAG laser posterior capsulotomy, no increase in IOP was observed by Cevher et al.[9] In the present study the persistent mild elevation of mean IOP than preoperative mean value, Contrary to Patel et al.[13] and Burq and Taqui[14] where IOP returned to normal level within 1 week.

Bhargava et al.[12] did ND-YAG laser capsulotomy for 30 patients, reported that IOP returned to normal values after 2 weeks except six of them developed sustained elevated IOP and referred to be treated at a glaucoma clinic.

After surgery, participants in this trial were given Prednisolone acetate cream for 1 week 0.2 % brimonidine tartrate twice daily and 1.0 % acetaminophen four times a day.

In current study there was a significant difference regarding CMT pre operatively and at first month and third month postlaser between both groups. CMT prevalence increased in both categories. The increase in CMT in diabetics (group I) was more

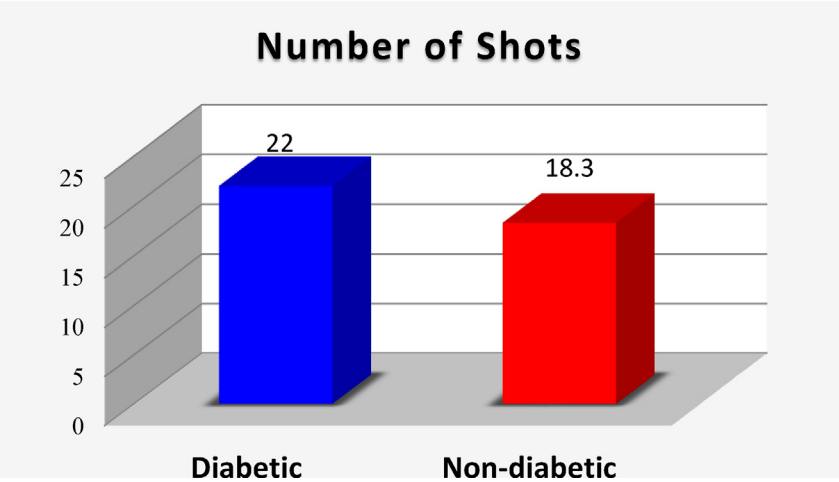

Fig. 4. Number of shots among the studied groups.

than in nondiabetics (group II) whether preoperatively and at various period of follow up. These increments were not due to the effect of ND-YAG laser in diabetics more than nondiabetics, but because the prelaser macular thickness already was more in diabetics than nondiabetic patients.

On comparison CMT prelaser and postlaser between both groups, there were significant differences at first and third month. The increase in CMT at third month in spite of statistically significant, but it was minimal elevation within 5 U that was not affect the BCVA where its mean at third month is 0.16 Log MAR.

The results of the present study as regard CMT is on line with the study of Giocanti-Aurégan et al.[15] and Abd-Elhafez et al.[16]

Ciftci and Filik[17] found that enhanced CMT after posterior ND-YAG laser capsulotomy, persist for 1 month in diabetic patient only but has no effect in BCVA. Their findings are consistent with those of the present study, in which the increase in CMT at the first and third months had no effect on the mean BCVA.

Wagdy et al.,[18] did ND-YAG laser posterior capsulotomy in diabetic patients only. They found increase in CMT at first, third, and sixth month. Their findings are comparable to those of the present investigation.

As regard to the total energy it was 67.8 ± 14.6 mJ in group and 63.9 ± 17.2 mJ in group II. There was no notable difference between the two categories. In spite of the mean total energy in present study less than 80 mJ, ND-YAG laser induce a significant increase in CMT in both groups. Similar to that reported by Ari et al.[4]

Laser capsulotomy with ND-YAG causes injury to the vitreous and an increase in inflammatory mediators. These mediators enhance perifoveal capillary permeability, leading to CME.[9]

4.1. Conclusion

Standard treatment for PCO is capsulotomy with a Nd: YAG laser. Patients with and without diabetes experienced a similar rise in CMT. Although not clinically observed, OCT follow-up revealed no difference between nondiabetic and controlled diabetics for these changes. The total energy of ND-YAG laser was found that had no effect on the increment of CMT. Diabetic patients exhibited a greater increase in CMT subsequent to Nd: YAG laser capsulotomy because the pre laser CMT values in diabetics were higher than nondiabetics. The age, sex, number of shots, and mean total energy used, all showed no significant effect on CMT postlaser.

4.2. Limitation

This study requires a large number of patients and requires long-term patients follow-up.

Conflicts of interest

There are no conflicts of interest.

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