ANALYSIS

24(104), July - August, 2020

ISSN
2321–7359
EISSN
2321–7367

Medical Science

Changes of anterior chamber depth and volume before and after Nd: YAG Laser posterior capsulotomy

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Article History
Received: 25 April 2020
Reviewed: 26/April/2020 *to* 11/June/2020
Accepted: 12 June 2020
E-publication: 19 June 2020
P-Publication: July - August 2020

Citation
Mahmoud Reza Panahi Bazaz, Gholamreza Khataminia, Mohammad Taayeed, Mohammad Sadegh Mirdehghan. Changes of anterior chamber depth and volume before and after Nd: YAG Laser posterior capsulotomy. *Medical Science*, 2020, 24(104), 2366-2372

ABSTRACT

One of the major barriers to achieving recovery upon cataract surgery is posterior capsule opacification (PCO). Nd: YAG Laser posterior capsulotomy, the method of choice in the treatment of PCO, can be associated with some adverse effect. The purpose of this study was to determine the relationship between intraocular lens displacements after Nd: YAG Laser posterior capsulotomy in

patient with PCO. The observational study was carried out in patients referred to the eye clinic at Imam Khomeini Hospital, Ahvaz, Iran. Visual performance was assessed by visual acuity examination, sensitivity to light source prior to Nd: YAG laser posterior capsulotomy, and contrast sensitivity. Intraocular lens displacement was measured before and after procedure by anterior chamber Optical Coherence Tomography (OCT) and anterior chamber depth changes were measured using Pentacam. In the current study 50 patients including 29 male and 21 female were evaluated. The mean age of patients was 64 ranging, 40 to 88. Anterior chamber depth (ACD) decreased significantly from 4.38 (before) to 4.04 (after). Similarly, anterior chamber volume (ACV) was significantly decreased one month after Nd: YAG laser procedure. Anterior chamber angle (ACA) increased significantly from 38.05 to 42.56. Spherical equivalence (SE) before and after procedure were -0.06 and -1.05, which indicate the significant toward movement of IOL. In conclusion our study has indicated the intraocular lens displacement and its consequently refractive effects one month after Nd: YAG Laser posterior capsulotomy. We recommend future study with more sample size and longer follow up duration in addiction to evaluation of other adverse effect of procedure such of cystoid macular edema.

Keywords: Nd: YAG Laser, Posterior capsulotomy, Posterior capsule opacity

1. INTRODUCTION

Posterior capsule opacification (PCO) is the most common and significant complication of modern cataract surgery, which is associated with a decrease in the patient's visual function. PCO is a common complication, especially after cataract surgery (Sinha et al., 2013; Raj et al., 2007; Awasthi et al., 2009). Six major factors have suggested associating with PCO, which including Cortical cleaving hydrodissection, Intraocular lens fixation, Spherical integration capsulorhexis diameter slightly smaller than optical IOL, a maximal ratio of Optic IOL to the posterior capsule and the geometry of the intraocular lens (Apple et al., 2001). Hydrogel Intraocular lens is associated with the highest amount of capsule turbidity, while PMMA is in the middle grade and silicon and acrylic lenses associated with the lowest capsule turbidity (Hollick et al., 2000). There are various methods for the treatment of posterior capsule turbidity, among which Nd: YAG Laser posterior capsulotomy provides a significant improvement in patient visual function as well as improved visualization of the peripheral fundus. The effects of this method on early peripheral diagnosis Psuedohole and retinal break are particularly evident in patients with a high risk of retinal detachment (Bari, 2013). Before the introduction of YAG: Nd laser, surgical incisions by posterior capsule polishing was the only treatment of cataract surgery induced posterior capsule opacification (Menapace et al., 2005).

Neodymium: Yttrium-Aluminum Garnet (YAG) is a 1064-mm solid-state laser that can destroy intraocular tissues. Light refraction results in ionization and plasma formation in the ocular tissue. Plasma formed by acoustic waves and shock waves destroys tissues (Karahan et al., 2014). Nowadays, Nd: YAG Laser Posterior Capsulotomy is an effective and relatively safe technique that eliminates posterior capsule opacity (Gomaa & Liu, 2011). Using YAG Laser capsulotomy in the treatment of posterior capsule opacity may lead to a decrease in visual acuity and performance.

Side effects of Nd: YAG Laser capsulotomy, which may lead to vision loss are not common. increase intraocular pressure, retinal rupture, intraocular lens destruction, endophthalmitis, irritation, corneal edema, Cystoid macular edema (CME), inflammation, Vitreous and macular holes are some of the side effects of this procedure. Therefore, it seems reasonable to evaluate the benefits of this procedure before performing it (Gore, 2012). Physicians should consider evidence of the potential benefit of this procedure in patients' visual function which is more important in high myopic patients (Javitt et al., 1992). Accordingly, the purpose of this study was to determine the relationship between intraocular lens displacements after Nd: YAG Laser posterior capsulotomy in patient with PCO.

2. METHOD

Study design

The observational study was carried out in patients referred to the eye clinic at Imam Khomeini Hospital, Ahvaz, Iran. Patients with a confirmed diagnosis of cataract surgery induced PCO (PCO was clinically determined thorough slit lamp examination) were included. Those with any macular and optic nerve injury prior to Nd: YAG laser posterior capsulotomy, previous history of inflammation (due to interference with laser inflammation), anterior capsule contraction, mydriasis size less than 6 mm were excluded from the study. Demographic information, as well as information related to cataract surgery, was registered. The study has confirmed by the ethical committee of Ahvaz Jundishapur University of medical sciences (IR.AJUMS.REC.1397.965). Written informed consent was obtained from all patients.

Measurements

Visual performance was assessed by visual acuity examination, sensitivity to light source prior to Nd: YAG laser posterior capsulotomy, and contrast sensitivity. These evaluations were repeated one month after the procedure; visual acuity was measured using Snellen. Contrast sensitivity testing was carried out by the Vision Contrast Test System on the basis of the lowest level of contrast that the patient could identify the direction of the line. The sensitivity to the light source was measured by producing an off-axis radius of light to the patient's eye, which would reduce the patient's vision on the Snellen chart as a result of light scattering through the opacity of the eye. Intraocular lens displacement was measured before and after Nd: YAG laser by anterior chamber OCT. In addition, anterior chamber depth changes were measured by Pentacam before and after the procedure. Finally, the effect of anterior chamber depth and intraocular lens displacement on refractive was evaluated.

Statistical analysis

All data were analyzed by descriptive statistics, including mean, median, standard deviation, frequency, and percent. Mean change levels before and after the intervention were analyzed by a paired- t-test. All statistical analysis was performed by SPSS, Inc. statistical software. Chicago, IL. A p-value of less than 0.05 considered significant.

3. RESULTS

In the current study 50 patients including 29 male and 21 female were evaluated. The mean age of patients was 64 in the range of 40 to 88 with standard deviation of 11. All variables except of SE after Nd:Yag had normal distribution (Table 1).

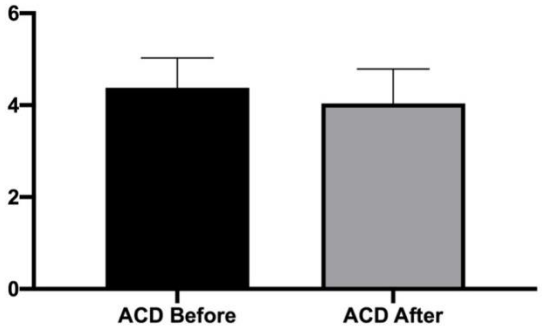
Table 1 Descriptive analysis of variables

Variables	Mean	Std. Deviation	Minimum	Median	Maximum	Passed normality test (alpha=0.05)
Age	64	11	40	63	88	Yes
ACD Before	4.4	0.65	2.9	4.3	5.7	Yes
ACD After	4.0	0.75	2.4	4.0	5.7	Yes
ACV Before	192	46	100	196	272	Yes
ACV After	182	38	91	185	248	Yes
ACA Before	38	9.2	20	37	57	Yes
ACA After	43	6.8	24	43	59	Yes
SE Before	-0.057	1.2	-2.3	0.25	2.2	No
SE After	-1.0	1.0	-2.9	-0.90	1.1	Yes

Anterior chamber depth (ACD) decreased significantly from 4.38 (before) to 4.04 (after) (Figure 1). Similarly, anterior chamber volume (ACV) was significantly decreased one month after the procedure (Figure 2). Anterior chamber angle (ACA) increased significantly from 38.05 to 42.56 (Figure 3). Spherical equivalence (SE) before and after operation was -0.06 to -1.05 (Figure 4), which indicate the significant toward movement of IOL (Table 2).

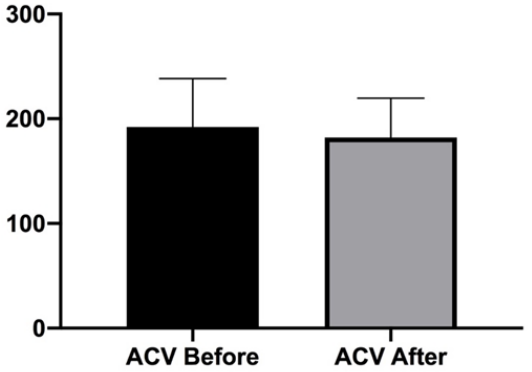
Table 2 Before and after operation changes in studied variable

Variables	Before	After	Before - After	P value
ACD	4.38±0.65	4.04±0.75	0.34	<0.0001
ACV	192.20±46.11	182.01±37.55	10.19	<0.0001
ACA	38.05±9.18	42.56±6.79	-4.51	<0.0001
SE	-0.06±1.20	-1.05±1.01	0.99	<0.0001



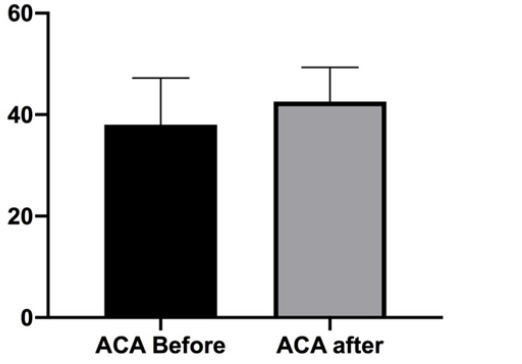
P value	<0.0001
P value summary	****
Significantly different (P < 0.05)?	Yes

Figure 1 Anterior Chamber Depth before and after Yag capsulotomy



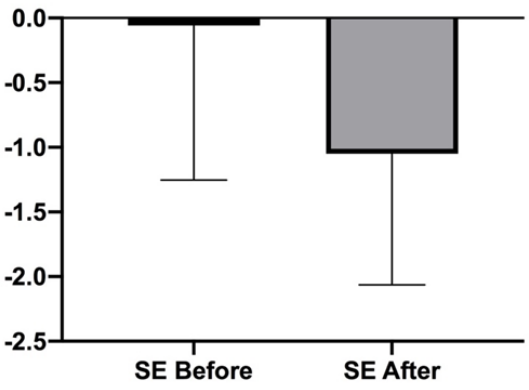
P value	<0.0001
P value summary	****
Significantly different (P < 0.05)?	Yes

Figure 2 Anterior Chamber Volume before and after Yag capsulotomy



P value	<0.0001
P value summary	****
Significantly different (P < 0.05)?	Yes

Figure 3 Anterior Chamber Angle before and after Yag capsulotomy



P value	<0.0001
P value summary	****
Significantly different (P < 0.05)?	Yes

Figure 4 Spherical Equivalence before and after Yag capsulotomy

The changes in ACD, ACV, ACA and SE were separately analyzed in male and females, The results showed relatively similar results in both genders (Table 3).

Table 3 Gender stratified before and after operation changes in studied variable

Variables		Before	After	Before - After	P value
ACD	Male n=29	4.467±0.764	4.137±0.876	0.331	<0.0001
	Female n=21	4.25±0.44	3.90±0.52	0.36	<0.0001
ACV	Male n=29	198.503±52.331	185.027±43.927	13.476	<0.0001
	Female n=21	183.49±35.18	177.84±26.85	5.65	0.02
ACA	Male n=29	39.500±10.534	43.506±8.145	-4.006	<0.0001
	Female n=21	36.05±6.61	41.25±4.13	-5.20	<0.0001
SE	Male n=29	-0.909±1.146	0.080±1.380	-0.989	<0.0001
	Female n=21	-1.24±0.78	-0.25±0.88	-1.00	<0.0001

4. DISCUSSION

Since the introduction of new methods of ophthalmic surgery, there has been a growing desire and effort to achieve the best possible outcome for the patient after undergoing surgery, which has made significant advances in this regard. As new surgical procedures and technologies are introduced, surgeons 'standards and patients' expectations have been improved as well. The purpose of cataract surgery today is to remove the opacity of the lens. In modern medicine, cataract surgery is a state-of-the-art

surgery that not only has no serious side effects most of the times, but also gives the patient the best visual performance without the need for correction, and sometimes even cures other refractive disorders.

One of the major barriers to achieving this goal is posterior capsule opacity (PCO), which is recognized as the most common complication of cataract surgery worldwide. There have been numerous studies and models to reduce the incidence of this complication, including retention of the entire posterior capsule and parts of the anterior capsule, 360-degree coverage of sense by anterior capsule, and use of biocompatible materials (Smith et al., 2004; Wormstone, 2020; Ursell et al., 2018). However, PCO remains the most common reason for referring patients to the eye clinic after cataract surgery (Awasthi et al., 2009). One of the common side effects of cataract surgery is subluxation (Malekahmadi & Kazemi, 2020; Werner et al., 2012). The present study attempted to evaluate the parametric changes of the anterior chamber one month after Nd: YAG capsulotomy.

In this study, it was found that forward IOL displacement one month after capsulotomy leads to a decrease in anterior chamber depth and consequently, myopia. This finding is consistent with the results of the Zaidi study (Zaidi & Nasir Askari, 2004). In other studies conducted separately by Ozkurt, Thornval, and Vrijman, there was no statistically significant change in the anterior chamber depth (Ozkurt et al., 2009; Thornval & Naeser, 1995; Vrijman et al., 2012). On the other hand, Find and colleagues in their study reported IOL backward movement and hyperopia immediately after capsulotomy, which was not statistically significant (Findl et al., 1999). These differences can be justified in two ways. First, the ACD measurement in the Thornval & Naeser (1995) study was performed using Pachymeter (Haag Streit, Switzerland), Ozkurt et al. (2009) also used Pac Scan for this purpose. The pentacam (10-micron sensitivity) which used in present study has much more sensitivity than Pachymeter. Second, Thornval also considers the corneal thickness in measuring anterior chamber depth, which reduces the measurement sensitivity. Findi et al. (1999) used the Dual Beam Partial Coherence Interferometer for measuring the depth of the anterior chamber immediately after surgery, which has lower sensitivity of our method and could justify the discrepancy compared to our measurement method. Pentacam allows the user to quickly measure and evaluate the anterior chamber without direct eye contact. The device identifies 2 points of varying height at the corneal surface and provides a three-dimensional model of the anterior segment. It can thus measure the depth, angle, and volume of the anterior chamber. This device has been proven more accurate than Orbscan and A-scan.

5. CONCLUSION

Our study has indicated the intraocular lens displacement and its consequently refractive effects one month after Nd: YAG Laser posterior capsulotomy thorough the more accurate way. Obviously, longer followup duration in addition to larger sample size and also evaluation of other possible complication of the procedure such as cystoid macular edema could provide more reasonable results and may be considered as the main limitation of our study which would recommend for future study.

Acknowledgment

The financial support of the research was provided by Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. We thank all who helped us to establish the research.

Ethical approval

The ethical code of the study in ethics committee is: IR.AJUMS.REC.1397.965

Conflict of interest

Authors have no conflict of interest to declare.

Funding: This research was funded by Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.

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