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Biometric and intraocular pressure changes after Nd:YAG laser capsulotomy

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ABSTRACT

Objectives. We aimed to investigate the influences of Nd:YAG (neodymium-doped yttrium aluminum garnet) laser capsulotomy on ocular biometric parameters. ***Methods.*** In this prospective study, 117 eyes of 117 pseudophakic patients were included. Full ocular examination, the best-corrected visual acuity (BCVA), and intraocular pressure (IOP) measurements were performed before the procedure as well as one week, one month, and three months after Nd:YAG laser capsulotomy. The axial length (AL), central corneal thickness (CCT), anterior chamber depth (ACD), and pupil diameter (PD) were measured by LenStar 900 optical biometry. The measurements were repeated one week, one month, and three months. ***Results.*** The BCVA improvements at preoperative, one week, and one month were statistically significant, but no significant changes in the BCVA were found at one month and three months (p=0.345). No association was found between the capsulotomy and mean IOP changes during the follow-up period (p=0.300). No significant changes were found in the CCT (p=0.059). The ACD changes occurred at preoperative; the first week and the first month were statistically significant (p<0.001). No statistically significant differences were found between the first month and the third month (p=0.365). No significant changes in the pupil size (p=0.200) and AL (p=0.112) were found after Nd:YAG laser capsulotomy. ***Conclusions.*** Our study demonstrated that the BCVA parameter changed after Nd:YAG laser capsulotomy. The BCVA and ACD values follow-up period should be at least one month after Nd:YAG capsulotomy.

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Keywords: Ocular biometry, Nd:YAG laser capsulotomy, LenStar, posterior capsular opacification

Introduction

Posterior capsular opacification (PCO) is the most common complication that occurs after extracapsular cataract extraction or phaco-emulsification [1]. It develops as a consequence of the proliferation of remaining epithelial cells and their migration to the space between the intraocular lens (IOL) and the posterior capsule [2, 3]. Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser capsulotomy is an effective technique and the so-called gold standard for treating visually significant PCO in pseudophakic eyes [4]. A number of complications can occur after YAG laser capsulotomy, such as an increase in intraocular

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pressure (IOP), the rupture of the anterior vitreous face, damage to the IOL, hyphema, acute iritis, and cystoid macular edema (CME) [5, 6]. Unusual complications include corneal endothelial damage, a macular hole, vitreous hemorrhage, retinal detachment, macular hemorrhage, and endophthalmitis [7-11]. To detect any of these complications and to take possible precautions, it is important to evaluate both the anterior and posterior segments before and after Nd:YAG laser capsulotomy. Conventional imaging of the anterior segment was applied with slitlamp biomicroscopy; however, the objective quantitative assessment of anterior segment parameters was limited. Recently, LenStar LS 900 optical biometry (Haag-Streit AG) has become useable in the clinical setting. The technology is based on optical low-coherence reflectometry with an 820 mm superluminescent diode. This noninvasive and noncontact examination offers the rapid collection and easy analysis of ocular biometric parameters. This optical biometer measures the axial length (AL), central corneal thickness (CCT), anterior chamber depth (ACD), lens thickness (LT), pupil diameter (PD), and keratometry (K) values of the eye in a single step [12]. The evaluation of the changes in the ocular biometric parameters after Nd:YAG laser capsulotomy may enable us to understand the dynamic mechanism of the eye and related complications.

In this prospective study, we aimed to investigate the influences of Nd:YAG laser capsulotomy on the best-corrected visual acuity (BCVA), IOP, CCT, ACD, AL, and pupil size in patients with PCO. To the best of our knowledge, the alterations in these parameters as measured with LenStar LS 900 optical biometry have not been previously reported.

Methods

This prospective study was performed in the Department of Ophthalmology at Adiyaman University Hospital in Turkey between February 2015 and December 2015. This study was performed in accordance with the Declaration of Helsinki, and informed consent was obtained from each patient before the study. Adiyaman University Institutional Ethics Committee approval was obtained. In this prospective study, 117 eyes of 117 pseudophakic patients were included. All of the patients had undergone non-complicated small-incision phaco-emulsification surgery with three-piece hydrophobic acrylic intraocular lens (Sensar, Advanced Medical Optics, Santa Ana, CA, USA) implantation at least six months earlier. All patients had significant vision loss (at least two lines compared to the most recent visit) and hazy fundus appearance. Exclusion criteria were complications related to cataract surgery, corneal pathology, pseudoexfoliation, glaucoma, uveitis, glaucomatous optic neuropathy, previous ocular surgery or trauma, and posterior segment pathology. Ocular examination with slitlamp biomicroscopy, BCVA, IOP measurements, and fundoscopy were performed before the procedure as well as one week, one month, and three months after Nd:YAG laser capsulotomy. The BCVA was measured with an office-based Snellen system, and the IOP was measured with a Goldmann applanation tonometer (Haag-Streit, Bern, Switzerland). The IOP measurements were repeated three times, and the average values were used in the analysis.

The posterior capsulotomies were performed by the same surgeon (AS) in a single session with an Nd:YAG laser, Visulas YAG III (Carl Zeiss Meditec AG), and a contact lens (Abraham capsulotomy lens) with an average diameter of 4.0 mm with a crisscross pattern. The Nd:YAG laser was posterior defocused by 0.50 mm in every eye. The spot energy level, total spot count, and total energy use of each patient were recorded. After the Nd:YAG laser, inflammation was controlled with diclofenac (four times/day for one week) given to all patients. No procedure-related complications were detected.

All LenStar 900 measurements were obtained under standard dim-light conditions. The measurements were repeated three consecutive times, and the average measurement value was recorded. After the daily calibration of the biometer, measurements were performed in the same room conditions and without topical medication. At each measurement, the patient was fixated to a flashing red light during the measuring process. All measurements were repeated five consecutive times. The average measurement value was recorded. The AL (the anterior corneal surface to the central retinal pigment epithelium), CCT, ACD (the corneal endothelium to the anterior lens surface), and PD were measured. The pupil diameter was measured using the instrument's inbuilt edge-detection software. The measurements were repeated one week, one month, and three months after Nd:YAG laser capsulotomy. All measurements were performed by the same operator, who was masked to the subject's eye condition.

Statistical Analysis

Statistical analysis was performed with SPSS for Windows Version 15.0 (SPPS Inc, Chicago, Illinois, USA). All data were reported as averages and standard deviations. The Kolmogorov-Smirnov test was used to test for normality. In addition, non-parametric tests were used according to the results. Wilcoxon and Friedman were further used to compare the changes in the BCVA and ocular biometric parameters (CCT, ACD, PD, AL). A value of p<0.05 was considered to be statistically significant.

Results

We evaluated a total of 134 patients with PCO during the study period. Nine patients did not appear for the quarterly examination, three missed the monthly examination, and five were lost immediately after the treatment. After these exclusions, 117 patients with PCO remained as participants in the study. The mean follow-up was about 3.41±0.49 (range; 3-4) months. All patients underwent posterior capsulotomy with the cross technique.

Of the 117 patients, 45 were female (38.5%), and 72 were male (61.5%). The mean age was 62.82±7.40 (range; 45-79) years. Sixty-five (55.6%) right eyes and 52 (44.4%) left eyes were included in the study. The PCO type in 26 (22%) patients was the pearl type, was fibrous in 27 (23%), and was a combination of the two in 64 (55%). The mean applied energy was 14.91±2.79 mj, the mean spot count was 13.40±3.36, and the mean capsulotomy size was 3.53±0.82 mm.

The BCVA and IOP values before the procedure prior to the capsulotomy and at week one, month one, and month three are illustrated in Table 1. Significant changes occurred in the mean BCVA (p<0.001). The BCVA improvements at preoperative, one week, and one month were statistically significant, but no significant changes in the BCVA were found at one month and three months (p=0.345). No association was found between the capsulotomy and mean IOP changes during the follow-up period (p=0.300).

A comparison of the repeated measurements and repeatability analyses of the CCT, ACD, pupil size, and AL are shown in Table 2. No significant changes were found in the CCT (p=0.059). The ACD was found to be decreased in the follow-up period, but no change was found one month and three months later. The ACD values changes were statistically significant at preoperative, the first week and the first month measurements (p<0.001). No statistically significant differences were found between the first month and the third month (p=0.365). Also, no significant changes in the pupil size (p=0.200) and AL (p=0.112) were found after Nd:YAG laser capsulotomy.

Table 1. Visual acuity and intraocular pressure values in the study group (n=117 eyes)

	Before the procedure	1 week	1 month	3 month	*p*-value	Test
BCVA	0.30±0.06	0.76±0.05	0.84±0.06	0.85±0.05	<0.001*	Friedman
IOP	14.13±1.83	14.29±1.85	14.26±1.85	14.23±1.83	0.300	Friedman

BCVA=best corrected visual acuity, IOP=intraocular pressure (mmHg), *Significant changes

Table 2. The values of ocular biometric parameters in the study group (n=117 eyes)

	Before the procedure	1 week	1 month	3 month	*p*-value	Test
CCT (µm)	533.80±30.96	534.96±31.15	534.22±31.07	534.24±31.07	0.059	Friedman
ACD (mm)	4.31±0.73	4.23±0.72	4.22±0.72	4.22±0.72	<0.001*	Friedman
PD (mm)	2.86±0.38	2.85±0.39	2.84±0.37	2.84±0.39	0.120	Friedman
AL (mm)	22.89±0.82	22.88±0.81	22.87±0.83	22.88±0.81	0.067	Friedman

ACD=anterior chamber depth, PD=pupil size, CCT=central corneal thickness, AL=axial length, *Significant changes (repeated measures analysis of variance)

Discussion

Nd:YAG laser capsulotomy, which is the main treatment for PCO, developed after cataract extraction. So far, Nd:YAG laser has been used as the gold standard for the treatment of PCO. A number of studies have used different devices to examine the effects of Nd:YAG laser capsulotomy on ocular biometric parameters. These devices, such as optical coherence tomography, ultrasonic biomicroscopy, Orbscan scanning slit topography, the scanning peripheral anterior chamber depth analyzer, the Pentacam, and LenStar LS 900 optical biometry have been used for the qualitative and quantitative evaluation of the ocular biometric parameters of the eye [13, 14]. LenStar LS 900 optical biometry, which provides for noninvasive and noncontact examination, offers the rapid collection and easy analysis of the ocular biometric parameters [14].

Nd:YAG laser capsulotomy is usually a safe procedure but may sometimes cause complications [9]. Nd:YAG laser capsulotomy after the evaluation of the ocular biometric parameters may help us to understand the dynamics, and thus, it provides us with the support needed for taking precautions against associated complications [15]. The ocular biometric parameter effects of Nd:YAG laser capsulotomy used for PCO depend on the size of the capsulotomy, the amount of energy involved, and the intraocular lens types [15]. In our study, the sizes of the capsule opening and the intraocular lens were standard in all patients. The patients who could be measured with LenStar LS 900 optical biometry were added into the study. In addition, we applied the cross technique for the posterior capsule opening, and the posterior capsule opening was obtained with a lower number of shots. Therefore, Nd: YAG laser capsulotomy was performed at low energy in the study.

After Nd:YAG laser application, visual acuity is increased significantly. Oztas *et al*. [14] showed that the BCVA increased up to the first-month follow-up. Ruiz-Casas *et al.* [17] showed a significant increase in the BCVA up to the third-month control. We found a significant improvement in the BCVA ($p<0.001$). The BCVA improvements at preoperative, one week, and one month were statistically significant, but no significant changes were found in the mean BCVA at one month and three months ($p=0.345$). After Nd:YAG laser treatment, an increase in IOP is usually temporary [17]. The frequency of increased IOP after Nd:YAG laser capsulotomy is highly variable, ranging from 0.8% to 82% in different studies [18]. In some studies, the IOP was found to be unchanged [13, 16]. In our study, no association was found between the capsulotomy and IOP changes during the follow-up period ($p=0.300$).

Wroblewska-Czajka *et al.* [19] reported that postoperative CCT values increased compared to CCT values before the procedure. Oztas *et al.* [14] suggested that a statistically significant 10 µm decrease in CCT was detected after Nd:YAG capsulotomy. Ruiz-Casas *et al.* [17] reported thatno association was found between the capsulotomy and CCT values. In our study, no significant change was found in the CCT.

Several trials reported that they did not find significant changes in the ACD after Nd:YAG posterior capsulotomy [20-22]. Eliacik et al. [24] reported that postoperative ACD values increased compared to ACD values before the procedure. Zaidi and Askari [25] reported a significant decrease in the ACD after Nd:YAG capsulotomy. In our study, a significant change in the ACD was found. In the ACD values before the procedure, compared to after the first week and the first month, statistically significant changes were found ($p<0.001$). No statistically significant differences were found between the first month and the third month ($p=0.365$). Oztas et al. [14] suggested that a decrease in the ACD is related to the anterior displacement of the IOL, and possible mechanisms for the anterior displacement of the IOL include positive vitreous pressure, the disruption of capsule capsulotomy, and PD changes during the follow-up period. In our study, no significant change occurred in the PD. As far as we know, no studies have evaluated the AL in patients of Nd:YAG laser capsulotomy used for PCO. In our study, no significant change was found in the AL.

The Limitations of the Study

A limitation of this study is the lack of further correlations between the techniques type, capsulotomy size and IOL types (one piece, three-piece, et cetera. Moreover, the effects of Nd:YAG capsulotomy on the ocular biometric parameters might be further evaluated. Additional studies to investigate the association of these factors with increased number of patients are required to substantiate our results.

Conclusions

The BCVA and ACD values were found to be unchanged after one month. In other words, the follow-up period should be at least one month after Nd:YAG capsulotomy. The data from our study demonstrated that ocular biometric parameters, such as CCT, ACD, PD, and AL, measured by LenStar LS 900 optical biometry may change after Nd:YAG laser capsulotomy. To the best of our knowledge, this is thefirst study to demonstrate the effects of Nd:YAG laser posterior capsulotomy onocular biometric parameters with LenStar LS 900 optical biometry.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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