

Short-term Impact of Nd:YAG Laser Capsulotomy on Anterior Segment Parameters

Nd:YAG Lazer Kapsülotominin Ön Segment Parametreleri Üzerine Yakın Dönem Etkisi

Raşit KILIÇ¹, Abdi Bahadır ÇETİN², Sebile ÜSTÜN ÇOMÇALI², Ali KURT¹

ABSTRACT

Purpose: The aim of this study was to investigate the effects of neodymium yttrium aluminum garnet (Nd:YAG) laser capsulotomy on axial length (AL), refraction, keratometry (K), white to white distance (WTW), central corneal thickness (CCT), anterior chamber depth (ACD) and pupil diameter.

Materials and Methods: We included pseudophakic patients with posterior capsule opacification complaining of decreased visual acuity, glare, or decreased contrast sensitivity who consecutively came to our clinic. All cases underwent Nd:YAG laser (Ellex Super Q, Adelaide, Australia) capsulotomy. The measurements were performed before and one week after the Nd:YAG laser capsulotomy using a Scheimpflug imaging system (Nidek Optical biometer AL-Scan, Gamagori, Japan).

Results: Thirty one eyes of 22 pseudophakic patients with clinically significant posterior capsule opacification were enrolled in the study. The mean pupil diameter was 5.47±1.18 mm before and 4.55±1.35 mm after Nd:YAG laser capsulotomy. There was a statistically significant change in pupil diameter (p=0,001). The average keratometric parameter K1 values before and after capsulotomy were 42.67±2.80 D and 42.54±2.81 D respectively. This difference was statistically significant (p=0.040). The changes in AL, spherical and cylindrical powers, K2, mean K, WTW, CCT and ACD were not found statistically significant (p=0.247, p=0.484, p=0.686, p=0.769, p=0.085, p=0.138, p=0.171 and p=0.891 respectively).

Conclusion: We found no statistically significant change in AL, ACD, CCT, mean K, K2, WTW, spherical and cylindrical powers after Nd:YAG laser capsulotomy. However, we found a statistically significant change in K1 and pupil diameter in this study.

Key Words: Anterior chamber depth, Nd:YAG laser capsulotomy, posterior capsule opacification.

ÖZ

Amaç: Bu çalışmanın amacı neodymium yttrium aluminum garnet (Nd:YAG) lazer kapsülotominin aksiyel uzunluk, refraksiyon, keratometri (K), kornea çapı, merkezi kornea kalınlığı, ön kamara derinliği ve pupilla çapı üzerine etkisini değerlendirmektir.

Gereç ve Yöntem: Kliniğimize azalmış görme keskinliği, kamaşma veya azalmış kontrast duyarlılığı şikayetleri ile başvuran arka kapsül kesafeti olan olgular çalışmaya dahil edildi. Tüm olgulara Nd:YAG lazer (Ellex Super Q, Adelaide, Australia) kapsülotomi yapıldı. Nd:YAG lazer kapsülotomiden önce ve bir hafta sonra Scheimpflug görüntüleme sistemi (Nidek Optical biometer AL-Scan, Gamagori, Japan) ile ölçümler yapıldı.

Bulgular: Psödo-fakik 22 hastanın klinik olarak anlamlı arka kapsül kesafeti olan 31 gözü bu çalışmada değerlendirildi. Ortalama pupilla çapı Nd:YAG lazer kapsülotomi öncesinde 5.47±1.18 ve sonrasında 4.55±1.35 mm olarak ölçüldü. İstatistiksel olarak anlamlı pupilla çapı değişimi vardı (p=0.001). Ortalama K1 parametresi kapsülotomi öncesi 42.67±2.80 D ve sonrası 42.54±2.81 D olarak ölçüldü. Bu farklılık istatistiksel olarak anlamlıydı (p=0.040). Aksiyel uzunluk, sferik ve silindirik güçler, K2, ortalama K, kornea çapı, merkezi kornea kalınlığı ve ön kamara derinliği değişimleri istatistiksel olarak anlamlı bulunmadı (Sırasıyla p=0.247, p=0.484, p=0.686, p=0.769, p=0.085, p=0.138, p=0.171 and p=0.891).

Sonuç: Nd:YAG lazer kapsülotomi sonrasında aksiyel uzunluk, ön kamara derinliği, merkezi kornea kalınlığı, ortalama K, K2, sferik ve silindirik güçler ve kornea çapı değişimleri istatistiksel olarak anlamlı bulunmadı. Ancak K1 ve pupilla çapı değişimleri istatistiksel olarak anlamlı bulundu.

Anahtar Kelimeler: Arka kapsül kesafeti, Nd:YAG lazer kapsülotomi, ön kamara derinliği.

- 1- M.D. Asistant Professor, Ahi Evran University Faculty of Medicine, Department of Ophthalmology, Kırşehir/TURKEY
KILIC R., kilicrasit@gmail.com
KURT A., dralikurt@gmail.com
- 2- M.D. Sivas Numune Training and Research Hospital, Eye Clinic, Sivas/TURKEY
CETIN A.B., drbahadir38@hotmail.com
USTUN COMCALI S., sebileustun@gmail.com

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Yazışma Adresi / Correspondence Address:

M.D. Asistant Professor, Rasit KILIC
Ahi Evran University Faculty of Medicine,
Department of Ophthalmology, Kırşehir/TURKEY

Phone: +90 346 444 44 58

E-mail: kilicrasit@gmail.com

INTRODUCTION

Posterior capsule opacification (PCO) is the most common long-term complication after cataract surgery.¹ After the surgery, remaining lens epithelial cells proliferate and migrate on the visual axis on posterior capsular surface and it is resulted in the secondary visual loss.² Posterior capsule opacification develops in a significant proportion of patients and the incidence of PCO increases with time after surgery.² The frequency and severity of PCO correlates to the use of surgical techniques, intraocular lens (IOL) optic edge designs and IOL materials.³ The treatment of PCO is based on decreased visual acuity and patients' complaints about glare and decreased contrast sensitivity. Neodymium yttrium aluminum garnet (Nd:YAG) laser capsulotomy is the gold-standard for the treatment of PCO. However, it has some complications such as damages in the IOL, increased intraocular pressure (IOP) and glaucoma, corneal injury, cystoid macular edema, retinal detachment, IOL dislocation or exacerbation of endophthalmitis.^{4,5}

The evaluation of the changes in the anterior segment parameters after Nd:YAG laser capsulotomy may allow important information understanding of ocular dynamics, refractive changes and mechanisms of complications. To our knowledge, the alterations in the anterior segment parameters as measured with Nidek Optical biometer AL-Scan have not been previously reported. In this study, for this reason, we aimed to investigate the effects of Nd:YAG laser capsulotomy on axial length (AL), refraction, keratometry (K), white to white distance (WTW), central corneal thickness (CCT), anterior chamber depth (ACD) and pupil diameter.

MATERIALS AND METHODS

This study was conducted at the Department of Ophthalmology, Sivas Numune Hospital. Pseudophakic cases with PCO complaining of decreased visual acuity, glare, or decreased contrast sensitivity who presented to our clinic were included in the study. The study was carried out in accordance with the principles of the Helsinki Declaration. An informed consent form was obtained from all participants.

Thirty one pseudophakic eyes (22 cases) with clinically significant PCO were included in the study. All IOL's were centralized and in the capsular bag before the procedure. Exclusion criteria were corneal pathology, glaucoma, uveitis, history of previous ocular surgery or trauma except phacoemulsification surgery and history of contact lens use for any reasons. Complete ophthalmic examinations were performed including visual acuity assessment with a Snellen chart, slit-lamp biomicroscopy, intraocular pressure measurement with the air-puff tonometer, dilated funduscopy. The examinations were performed before and one week after the Nd:YAG laser capsulotomy.

The measurements were performed by 2 experienced technicians before and one week after the Nd:YAG laser capsulotomy using a Scheimpflug imaging system (Nidek Optical biometer AL-Scan, Gamagori, Japan). Technicians were masked to clinical ophthalmic examination results. All of the measurements were taken in undilated pupil conditions and under identical lighting conditions.

The cases underwent Nd:YAG laser (Ellex Super Q, Adelaide, Australia) capsulotomy by the three ophthalmologists.

One drop of tropicamide 0.5% was instilled in each eye. After pupil dilation, capsulotomy was performed with Abraham capsulotomy lens. The overall capsulotomy size was aimed approximately 4 mm diameter and the minimum amount of energy was used (1-2.5 mJ). After the treatment, 0.1% dexamethasone sodium phosphate four times per a day and 0.15% brimonidine tartrate two times per a day were prescribed for 1 week.

The data was analyzed with the SPSS 22.0 (Chicago, Illinois, USA) software. Parametric and non-parametric tests were used according to the results. The Wilcoxon signed rank test and paired samples test were used for comparison of the parameters before and after Nd:YAG laser capsulotomy. The results were accepted as statistically significant when P value was lower than 0.05.

RESULTS

This study was conducted on 31 eyes of 22 patients consisting of 14 females and 8 males. The mean age of the patients was 69.4 ± 9.9 (49-86) years. The mean pupil diameter was 5.47 ± 1.18 mm before and 4.55 ± 1.35 mm after Nd:YAG laser capsulotomy. The difference between preoperative and postoperative pupil diameter was statistically significant ($p=0.001$). The average keratometric parameter K1 values before and after Nd:YAG laser capsulotomy were 42.67 ± 2.80 D and 42.54 ± 2.81 D respectively. This difference was statistically significant ($p=0.040$). The changes in AL, spherical and cylindrical powers, K2, mean keratometry (K), WTW, CCT and ACD were not found statistically significant ($p=0.247$, $p=0.484$, $p=0.686$, $p=0.769$, $p=0.085$, $p=0.138$, $p=0.171$ and $p=0.891$ respectively, Table). The mean AL, spherical and cylindrical powers, WTW, K1, K2, K, CCT, ACD and pupil diameter values before and after Nd:YAG laser capsulotomy are seen in table.

DISCUSSION

Recent technological developments in the anterior segment imaging techniques such as Scheimpflug imaging system, optical coherence tomography, partial coherence interferometry, scanning slit topography and optical low coherence reflectometry allow the evaluation of the anterior segment parameters.^{6,7} Understanding of the anterior segment dynamics may provide some benefits in the clinical practices of ophthalmology such as management of glaucoma and interventions on anterior segment morphology.

Neodymium-yttrium-aluminum-garnet laser capsulotomy is a non invasive and fast operation and gold standard in cases with vision impairing PCO. Anterior chamber depth may alter after Nd:YAG laser capsulotomy. Findl et al.,⁸ reported that the capsulotomy can induce a backward movement of the IOL and it gives rise to deepening of the ACD. Besides, Elicaçık et al.,⁹ reported that vitreous cavitation and mechanical effects on zonules may cause backward shift to IOL position and these effects could depend on capsulotomy size. Otherwise, Zaidi and Askari¹⁰ reported the rupture of the anterior hyaloid surface can lead to anterior displacement of the vitreous and it is resulted to narrowing of the ACD.

Table: Anterior segment parameters are seen before and after capsulotomy.

Parameters	Before capsulotomy	After capsulotomy	P
AL (mm)	23.58±1.74	23.56±1.76	0.247
Spherical power (D)	0.23±1.88	0.46±1.65	0.396
Cylindrical power (D)	-1.42±1.22	-1.51±1.44	0.273
K1 (D)	42.67±2.80	42.54±2.81	0.040*
K2 (D)	43.74±2.30	43.72±2.22	0.769
Mean K (D)	43.18±2.52	43.10±2.48	0.085
WTW (mm)	11.57±0.69	11.72±0.55	0.138
CCT (µm)	527.10±35.69	529.20±37.38	0.171
ACD (mm)	4.89±0.51	4.32±0.53	0.891
Pupil diameter (mm)	5.47±1.18	4.56±1.35	0.001*

ACD; Anterior Chamber Depth, AL; Axial Length, CCT; Central Corneal Thickness, K; Keratometry, WTW; White To White distance, D; Diopter. *statistically significant.

Eliaçık et al.,⁹ found an increase in ACD after Nd:YAG laser capsulotomy. However, Oztas et al.,¹¹ reported a decrease in ACD, similar to our findings. While there are studies in the literature reporting a deeper or shallower ACD after Nd:YAG laser capsulotomy, no change in ACD in others.⁸⁻¹³ In addition, Khambhipant et al.,¹⁴ reported that there was no significant relationship between ACD and IOL types (one-piece and three-piece IOL). In our study, we found a decrease in ACD, however, it was not statistically significant.

The refraction can change after Nd:YAG laser capsulotomy. The alteration of ACD can cause a hyperopic or myopic shift in spherical equivalents. Oztas et al.,¹¹ reported a significant change in both spherical and cylindrical powers after capsulotomy. However, many studies reported that no statistically significant change was found for the spherical and cylindrical powers.^{12-14,15} Similarly, we did not find statistically significant change in both spherical and cylindrical powers.

There is a significant change in K1 values according to our results ($p=0,040$). However, the changes in K2 and mean K were not significant. Similarly, Oztas et al.,¹¹ reported no significant change in keratometric values. There is no significant change in CCT in this study. Pekel et al.,¹⁶ found a significant change in CCT at 1st hour, they also reported no significant change at 1st week and 1st month. Polat et al.,¹⁷ reported a significant increase in CCT at 1st week, but they found no significant change at 1st and 3rd month. Besides, the data in this study indicated that no significant difference was found in WTW and AL values. It also represented a significant change in pupil diameter values ($p=0.001$). After procedure, brimonidine tartrate two times per a day was prescribed for 1 week in this study. There are studies reporting a significant miosis after brimonidine tartrate in the literature.^{18,19} We therefore think that pupil diameter can be affected by brimonidine tartrate usage.

In conclusion, we found no statistically significant change in AL, ACD, CCT, mean K, K2, WTW, spherical and cylindrical powers after Nd:YAG laser capsulotomy. However, we found a statistically significant change in K1 and pupil diameter in this study. The results reveal that Nd:YAG laser capsulotomy is a safe and effective procedure for the treatment of PCO.

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