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Research Article

Effects of Nd: YAG Laser Capsulotomy on Visual Acuity, Central Macular Thickness, Intraocular Pressure and Refraction in Patients with Diabetes Mellitus

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Abstract

Aim: This study aimed to evaluate the effects of Nd: YAG laser posterior capsulotomy (YAG PC) on best-corrected visual acuity (BCVA), central macular thickness (CMT), intraocular pressure (IOP), and refraction in patients with diabetes mellitus (DM).

Material and Methods: This retrospective study included patients who underwent YAG PC due to posterior capsular opacification (PCO). BCVA, refraction examination results, IOP, and CMT of the patients were evaluated. All patients were examined before, one day, and one month after the treatment.

Results: The study included 56 eyes from 48 diabetic patients (diabetic group, Group 1) and 61 eyes from 50 nondiabetic patients (nondiabetic group, Group 2). In Group 1, a significant increase was observed between pre-treatment BCVA and the first-day and first-month BCVAs. Similarly, a significant increase was observed on the first day and first-month CMT compared to the pre-treatment CMT. On the other hand, a significant increase was observed in Group 2 between pre-treatment BCVA and the first-day and first-month BCVAs. However, no significant increase was observed between pre-treatment and the first-day and first-month CMT.

Conclusion: Although CMT has increased in patients with DM after YAG PC, applied for PCO treatment, this increase did not affect the visual recovery.

Keywords: Central macular thickness, diabetes mellitus, intraocular pressure, laser capsulotomy, refraction

INTRODUCTION

The most common postoperative complication of cataract surgery is PCO (1); its incidence after cataract surgery varies between 10%-50% (2,3). The main reason for PCO development is the proliferation of the lens epithelial cells remaining in the capsule and their settlement on the posterior capsule (4). Regarding patients undergoing cataract surgery, PCO development has been reported to be significantly higher in patients with DM than in those without DM. However, there is no correlation between the stage of diabetic retinopathy, the systemic involvement of DM, and the severity of PCO (5,6). YAG PC treatment, preferred for PCO, is a non-invasive method; it does not require patient hospitalization and can be administered quickly (7). In addition, this treatment method creates a central opening in the thickened posterior capsule, obtaining effective results immediately (8). However, complications such as maculopathy and increased IOP may occur after YAG PC (9-11).

This study aimed to compare CMT, IOP, BCVA, and refraction changes observed on the first day and one month after YAG PC in patients with and without DM who developed PCO after cataract surgery.

MATERIAL AND METHOD

PCO is a disease that causes a decrease in visual acuity. It can be treated with YAG PC (12). YAG PC was applied for the patients who came to our clinic with decreased

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visual acuity and who were detected to have PCO in the slit-lamp examination. Patients who underwent phacoemulsification and intraocular lens implantation were included in this retrospective study. It was approved by Istanbul Training and Research Hospital Clinical Trials Ethics Committee. Patients treated with YAG PC for PCO at Istanbul Training and Research Hospital between March 2018 and May 2019 and whose PCO was sufficient for macular examination with pre-treatment OCT were included in the study.

Patients who had severe ocular pathologies, such as complications in cataract surgery in their history or examination, a follow-up period of less than one month, corneal haze, a history of eye surgery other than cataract, a systemic disease that will increase inflammation after YAG PC, retinal diseases, glaucoma, and uveitis were excluded. BCVA, refraction examination, biomicroscopy and IOP measurement were performed in all control. CMT was then measured by spectral-domain OCT (RVTue 100-2; Optovue, Fremont, CA). IOP measurement was performed three times with Topcon CT-80 non-contact tonometer (Topcon, Japan), taking their average. In addition, 1% tropicamide and 2.5% phenylephrine were administered before capsulotomy for pupil dilation. 0.5% proparacaine hydrochloride drops were applied to the eyes 5 minutes before the treatment for anaesthesia. YAG PC was performed by focusing on the posterior capsule, creating an opening of approximately 4 mm. According to the capsule thickness, the power was set between 1 and 2.4 mJ. Each capsulotomy was completed in a single session. One surgeon performed the treatment using a Zeiss Visulas Yag II Laser (Zeiss, Germany). After the treatment, patients were prescribed brinzolamide 1%+ timolol 0.5% combination topical antiglaucomatous drops (twice a day) and prednisolone acetate 1% (four times a day) to be used for one week. All patients were examined before, one day, and one month after the treatment.

The patients included in the study were divided into two groups: Group 1, patients with DM, and Group 2, patients without DM.

Statistical analysis

SPSS version 22.0 was used in statistical analysis. A paired t-test was used to compare BCVA, IOP, CMT, and spherical and cylindrical values before and after the treatment in Group 1. In contrast, the repeated measures ANOVA test was used in Group 2. The independent samples t-test was used to compare groups. As a result of the comparison, the effect size was determined as 0.5, using Gpower (version 1.3.9.7). The power of the analyses was calculated as 0.873.

RESULTS

56 eyes of 48 patients (diabetic group, Group 1) and 61 eyes of 50 patients (nondiabetic group, Group 2) were included in the study. Patients' demographic characteristics are shown in Table 1. BCVA, IOP, CMT, spherical and cylindrical values of Group.

Table 1. Demographic characteristics of patients

	Group 1 n:48	Group 2 n:50	p
Age	69.8±4.9	69.1±9.9	0.874 (Independent samples t test)
Gender (female/male)	26/22	28/22	0.435 (Chi-square test)
Follow-up time (Months)	1	1	

1 before and after the treatment are shown in Table 2. Comparing pre-treatment BCVA and first-day and first-month BCVAs shows a significant increase. Besides, significant increases are observed between pre-treatment IOP and first-day IOP (in 2 patients); IOP was brought under control with anti-glaucomatous drop therapy. There is no significant change between pre-treatment IOP and first-month IOP. A significant increase is observed between pre-treatment CMT and first-day and first-month CMT. There is no significant difference in spheric value on the first day or one month after the treatment. No significant change occurred in the cylindric value the day after the treatment; however, there is a significant decrease one month after the treatment.

BCVA, IOP, CMT, spherical and cylindrical values of Group 2 before and after the treatment are shown in Table 3. There is a significant increase between pre-treatment BCVA and first-day and first-month BCVAs. However, there is no significant change between pre-treatment IOP and first-day and first-month IOPs. Similarly, no significant change is observed between pre-treatment, first-day, and first-month CMTs. Regarding spheric and cylindric values, there is no significant change between pre-treatment and first-day values, whereas a significant decrease is observed in the first-month value.

The comparison of BCVA, IOP, CMT, spherical value, and cylindrical values between groups before and after the treatment is shown in Table 4. There is no statistically significant difference in BCVA, CMT, spherical value, and cylindrical values between the two groups before and after the treatment. In contrast, first-month IOP is significantly higher in Group 1.

The day after YAG PC, +1 cell was detected in the anterior chamber in 4 patients in Group 1 and 6 in Group 2. Anterior chamber reaction disappeared on the third day after topical steroid treatment, which was started routinely, and then the treatment was tapered and discontinued.

In addition, macular edema was detected in 1 patient in Group 1 and Branch Retinal Vein Occlusion (BRVO) in 1 patient in Group 2 during the first month of follow-up. The macular edema in the patient with DM returned to normal after intravitreal bevacizumab treatment. The BRVO patient underwent focal laser photocoagulation and was further followed.

Table 2. BCVA, IOP, CMT, spherical and cylindrical values of the Group 1 before and after the treatment		
	Group 1 n:56	**P (Paired t test)**
BCVA (logMAR)		
pre-treatment	0.44±0.36	
first-day	0.14±0.19	**<0.001**
first-month	0.09±0.15	**<0.001**
IOP (mmHg)		
pre-treatment	15.9±2.2	
first-day	18.6±8.3	**0.002**
first-month	16.0±2.2	0.431
CMT (µm)		
pre-treatment	262.7±37.2	
first-day	266.5± 38.2	**0.031**
first-month	267.0± 37.3	**0.036**
Spherical values (diopter)		
pre-treatment	+0.23±1.27	
first-day	+0.32±1.03	0.772
first-month	+0.21 ±1.10	0.101
Cylindrical values (diopter)		
pre-treatment	-1.07±0.70	
first-day	-0.88± 0.36	0.192
first-month	-0.71±0.73	**0.004**

Table 3. BCVA, IOP, CMT, spherical and cylindrical values of the Group 2 before and after the treatment		
	Group 2 n:61	**P (Repeated measures ANOVA test)**
BCVA (logMAR)		
pre-treatment	0.48±0.30	
first-day	0.14±0.11	**<0.001**
first-month	0.06±0.08	**<0.001**
IOP (mmHg)		
pre-treatment	15.8±2.4	
first-day	15.5±2.6	0.321
first-month	15.0±3.7	0.485
CMT (µm)		
pre-treatment	259.7±19.8	
first-day	255.8±23.4	0.218
first-month	258.7±27.3	0.642
Spherical values (diopter)		
pre-treatment	+0.61±1.0	
first-day	+0.42±0.93	0.153
first-month	+0.33.±0.96	**0.021**
Cylindrical values (diopter)		
pre-treatment	-1.08±0.61	
first-day	-0.89±0.57	0.241
first-month	-0.72±0.49	**0.012**

Table 4. The comparison of BCVA, IOP, CMT, spherical value, and cylindrical values between groups before and after the treatment

	Group 1 N:56	Group 2 N:61	P (Independent samples t test)
BCVA (logMAR)			
pre-treatment	0.44±0.36	0.48±0.30	0.227
first-day	0.14±0.19	0.14±0.11	0.329
first-month	0.09±0.15	0.06±0.08	0.960
IOP (mmHg)			
pre-treatment	15.9±2.2	15.8±2.4	0.619
first-day	18.6±8.3	15.5±2.6	0.056
first-month	16.0±2.2	15.0±3.7	0.014
CMT (µm)			
pre-treatment	262.7±37.2	259.7±19.8	0.398
first-day	266.5± 38.2	255.8±23.4	0.557
first-month	267.0± 37.3	258.7±27.3	0.760
Spherical values (diopter)			
pre-treatment	+0.23±1.27	+0.61±1.0	0.382
first-day	+0.32±1.03	+0.42±0.93	0.962
first-month	+0.21 ±1.10	+0.33.±0.96	0.850
Spherical values (diopter)			
pre-treatment	-1.07±0.70	-1.08±0.61	0.653
first-day	-0.88± 0.36	-0.89±0.57	0.981
first-month	-0.71±0.73	-0.72±0.49	0.942

DISCUSSION

YAG PC is the standard treatment for PCO (7). Although it is a reliable treatment method, complications such as IOP changes, refraction changes, and macular edema may occur afterwards (9-11). The causes of macular edema developing after YAG PC are the deterioration of the perifoveal inner blood-retinal barrier with the increase of inflammatory mediators such as prostaglandin and leukotrienes released to the posterior segment, vitreous damage, and vitreous activation (13,14). It is known that the risk of developing cystoid macular edema is high in patients with DM due to functional damage and necrosis of the retinal capillaries (15,16). Macular edema was detected in 1 patient in Group 1 in the first month of follow-up. This study showed a significant increase in CMT the day after and one month after YAG PC in Group 1. However, no significant change was observed in Group 2. Many studies in the literature state that CMT increases or remains unchanged after YAG PC (17-21). There was no statistically significant difference in CMT between the groups after the treatment in this study. Only one study compared CMT in patients with and without DM in the literature, and its results were similar to this study (22). In addition, BRVO was detected in 1 patient in Group 2 in the first month of follow-up. In the literature, 1 case of central retinal vein occlusion developing after YAG laser capsulotomy has been reported (23).

A significant increase was observed in BCVA in both Group 1 and Group 2 at the end of the 1-month follow-up. However, there was no statistically significant difference in BCVA between groups. The study conducted by Türkoglu et al. showed similar results; however, Awan et al. reported that BCVA increased in both groups, but the BCVA increase was better in the nondiabetic patients (5,22).

The most common complication of YAG PC is IOP increase (24). Prophylactic antiglaucomatous drugs are used because of this IOP increase after the treatment. Studies in the literature reported an increase of 15-30% in IOP despite prophylactic treatment (25-26). However, Ozkurt et al. reported no significant change in IOP after YAG PC (27). In this study, despite prophylactic treatment, IOP was measured between 40-46 mmHg in 2 cases in Group 1; it was brought under control at the end of the first month. Regarding post-treatment IOP changes of the groups, there was no significant difference in Group 2. In contrast, there was a significant increase in the mean IOP in Group 1 on the first day after treatment; it returned to normal in the first month. The possible reason for this IOP increase in 2 patients in Group 1 may be the total number of shots used in the treatment and the high total energy, as stated in previous studies (28).

Although effective results have been obtained in PCO treatment with YAG PC, many different results have been reported regarding refractive changes. Akmaz et al. reported a significant myopic shift after YAG PC (29); Oztas et al. found both a significant myopic shift in spherical equivalent and a significant decrease in cylindrical refractive power (30). Zaidi et al. and Polat et al. reported a significant hyperopic shift in spherical equivalent after YAG PC (31,32). Hu et al. reported no significant changes in spherical equivalent, but they found a significant decrease in cylindrical refractive power (33). Chua et al., on the other hand, did not observe any significant change in spherical values after YAG PC (34). This study showed a statistically significant myopic shift in spherical equivalence and a decrease in cylindrical refractive power at the first-month control in Group 2. In Group 1, there was a shift in spherical equivalent to myopia on the first day and first month after the treatment, but it was not statistically significant. In addition, a significant decrease was observed in the cylindrical refraction power in the first month. Therefore, after YAG PC, it is necessary to wait one month for optical refractive correction.

Study Limitations

The limitation of the study is its retrospective nature and the failure to group according to the amount of energy used in YAG PC.

CONCLUSION

In conclusion, despite the increase in CMT in diabetic patients after the administration of YAG PC for PCO treatment, this increase did not affect visual recovery. YAG PC has similar effects in increasing visual rehabilitation in diabetic and nondiabetic patients, but more studies are needed to confirm this. Prospective studies with more patients and a more extended follow-up period are needed.

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