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Original Article

Does selective laser trabeculoplasty treatment affect anterior chamber angle?

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Abstract: The Selective laser trabeculoplasty (SLT) is a treatment method for primary open angle glaucoma (POAG). It applies laser beams directly to anterior chamber angle (ACA) and leads some degree of alteration in the trabecular meshwork. This study was conducted to evaluate ACA alterations after the SLT treatment. A prospective cross-sectional study performed on 53 eyes of 27 POAG patients. A single session of SLT was performed to previously untreated, non-operated, clear corneal eyes. Scheimpflug corneal topographic (SCT) measurements were performed before and at the 3rd month after SLT treatment. The central corneal thickness (CCT) measurements (pre-treatment 549.2±35.2 μm, post- treatment 545.6±36.9 μm) were found significantly reduced (P=0.007). SLT did not alter the quantitative measurement of the ACA (pre-treatment 39.6°±5.4, post treatment 40.0°±5.2; P=0.169). Anterior chamber depth remained unaffected from SLT (pre-treatment 3.29±0.2 mm, post treatment 3.29±0.2; P=0.827). In conclusion, a significant decrease in CCT was present without any alteration on ACA making SLT a favorable technique for POAG treatment.

Keywords: Cornea, corneal topography, glaucoma, intraocular pressure, selective laser trabeculoplasty

Introduction

Glaucoma is among the leading causes of blindness worldwide [1]. Intraocular pressure (IOP) reduction is the key point in glaucoma treatment. Selective laser trabeculoplasty (SLT) is a proven method to reduce IOP [2]. It uses a frequency-doubled short pulse Nd.YAG laser. The name “selective” has been given due to its targeting of pigmented trabecular meshwork cells while leaving the meshwork microstructure intact at anterior chamber angle (ACA) [3]. Some degrees of mechanical damage such as splitting and fragmentation of the trabecular beams of the trabecular meshwork after SLT have been reported in experimental studies [4-6]. However, there is not any information about ACA alterations after SLT in living organism. Additionally, some researchers prove a decrease in central corneal thickness (CCT) after SLT [7, 8]. Because the cornea is one of the major constituents of the ACA any alteration in its thickness may affect quantitative measurements of the ACA. In this study, we examined quantitative alterations of the ACA due to SLT treatment with a Scheimpflug corneal topography (SCT).

The SCT is a reliable device to analyze the anterior segment of the eye [9, 10]. It uses two cameras and measures the ACA quantitatively. The first camera rotates around the anterior segment and captures images in 3 dimensions. A second one captures eye movements for improved orientation of the images. SCT is a valuable quantitative diagnostic method in differentiation and follow-up of patients with glaucoma [9, 11-13].

In some ophthalmologic operations, in the treatment of glaucoma, ACA alterations have been reported and these alterations may result in acute and chronic inflammations of the anterior chamber. Li et al investigated the 3-D morphology changes of the anterior segment after laser peripheral iridotomy using rotating Scheimpflug camera and determined an increase in ACA after operation [14].

In this study we aimed to evaluate the ACA alterations with the SCT after SLT treatment in glau-

Table 1. The preliminary data of the patients

	N	Minimum	Maximum	Mean	Standard Deviation
C/D[a]	53	0.2	1.0	0.48	0.24
RNFL[b]	53	53	116	91.11	14.23
MD[c]	53	-31.4	6.6	-8.4	-7.2

[a]: Cup disc ratio; [b]: Retinal nerve fiber layer; [c]: Mean deviation of the automated visual field.

coma patients in a 3-dimensional manner. Since SLT is a commonly performed operation, any alterations in ACA should be known if present.

Materials and methods

General Information

Primary open-angle glaucoma (POAG) patients, older than 18 years of age, previously untreated with laser or filtering surgery, were included in this study. Patients with anterior segment pathologies and who could not be followed for at least 3 months were excluded. Patients were examined with gonioscopy to find out any angle pathology. A complete ophthalmologic examination was performed before SLT treatment and 3 months after the treatment. The IOP values before and after SLT were measured with a calibrated Goldmann tonometer. Patients were treated for one or combination of three reasons: reducing IOP, reducing the number of medication and controlling ocular surface discomfort. Preliminary cup/disk ratios, the mean deviation of the automated visual field examinations and retinal nerve fiber layer measurements were recorded. Same ophthalmologist treated patients (KA). Medication of the patients remained unchanged due to ethical reasons. Another ophthalmologist took the SCT images (AK). The study was conducted from January 2014 to December 2014. All authors followed the tenets of the declaration of Helsinki. Bagcilar Training and Research hospital ethic committee approved the study. Informed consent was obtained prior to treatment.

Scheimpflug corneal topography technique

The Sirius™ (CostruzioneStrumentiOftalmici, Italy) was used for SCT. All measurements were taken with the manufacturer's guideline. The mesopic condition was used to control pupillary effect. Patients were asked to blink before capturing images. All measurements were obtained between 10:00 and 16:00 o'clock to minimize diurnal variation. Only the good quality images were included. The measurements were taken prior to SLT and three months after the treatment.

Selective laser trabeculoplasty

The Ellex™ Solo laser (Adelaide, Australia) was used for SLT. A drop of topical anesthetic (proparacaineHCl 0.5%) was installed prior to treatment. Laser spots were applied to 360° of the trabecular meshwork. The energy levels were arranged from 0.8 to 1.3 mJ until a bubble formation was observed. All patients were received a nonsteroidal anti-inflammatory eye drop (nepafenac 1%, four times a day) for a week.

Statistical analysis

The SPSS 15.0 for Windows was used for statistical analysis. The distribution of the data was checked with the Kolmogorov-Smirnov test. Results are presented as mean ± SD for continuous variables and as proportions (%) for categorical variables. Paired-sample Student's t-test was used for comparisons. A *p*-value of less than 0.05 was regarded as statistically significant.

Results

Twenty-seven patients with a mean age of 58.28±9.32 years (range: 40-73years) were enrolled but, one patient has been operated from one eye thus, her operated eye was excluded. The numbers of male and female patients were 14 and 13, respectively. Pre-treatment and post-treatment third month IOP, ACA, and anterior chamber depth (ACD) measurements were found to be normally distributed with Kolmogorov-Smirnov test (P=0.113, P=0.362; P=0.623, P=0.531; P=0.677, P=0.95 respectively).

The eyes of the patients were receiving no medication or 1, 2, 3 and 4 medications prior to SLT (15.1%, 26.4%; 30.2%; 11.3%; 17.0% respectively). IOP reduction was the primary goal for 13 patients (48.1%). 11 patients (40.7%) were treated for reducing the amount of medication. Ocular discomfort due to medications was the

Table 2. Comparison of mean corneal topographical parameters and mean intraocular pressure with paired-sample Student's t-test

	Pre-treatment (n:53)		Post-treatment (n:53)		P
	Range	Mean ± SD	Range	Mean ± SD	
CCT (μm)[a]	486-629	549.2 ± 35.2	485-632	545.6 ± 36.9	0.007
ACD(mm)[b]	2.83-3.87	3.29 ± 0.2	2.8-3.9	3.29 ± 0.2	0.827
IOP (mmHg)[c]	10-33	18.0 ± 4.1	9-27	15.8 ± 4.2	0.001
ACA (°)[d]	28-54	39.6 ± 5.4	28-51	40.0 ± 5.2	0.169

[a]: Central Corneal Thickness; [b]: Anterior Chamber Depth; [c]: Intraocular Pressure; [d]: Anterior Chamber Angle.

forthcoming reason in 3 patients (11.1%). Other preliminary data of the patients are shown in **Table 1**.

A comparison of corneal topography findings before and after SLT treatment was displayed in **Table 2**. It also showed the IOP measurements. The mean ACA and ACD values were not significantly different (P=0.169 and P=0.827 respectively). There was a significant difference in the mean CCT and IOP measurements (P=0.007 and P=0.001 respectively).

Discussion

The SLT is one of the important treatment optionsof open-angle glaucoma [2]. Most of the studies about tissue changes after SLT treatment are histological and showing a small destruction of the trabecular meshwork [4-6]. In this study, we have evaluated the ACA alterations after SLT and did not determine a significant change in ACA with SLT treatment.

SLT is a virtuous method of glaucoma treatment due to minimal side effects, rapid recovery, and relative ease of the procedure [15]. Most of the previous studies reported good results with mild and transient side effects including, anterior chamber reaction, eye pain, non-specific conjunctivitis, corneal edema, and blurred vision [16-20]. A decrease in IOP has been reported in many previous studies in patients with POAG three months after SLT treatment [16-18]. Similarly, we also found a significant reduction in the mean IOP values in our study after SLT (P<0.001). The efficacy of SLT was reported as ranging from 40-70% in different studies [21, 22]. In this study, SLT was effective in all cases in decreasing IOP (P=0.001).

In our study, we have determined a statistically significant decrease in corneal thickness after SLT on the 3rd month follow up. There are a few reports on corneal changes after SLT. Minimal evidence of mechanical damage after SLT compared to argon laser trabeculoplasty (ALT) in human eye bank eye specimens have been reported before [4]. Ong et al reported that effects of SLT on normal corneas might be transient and negligible [7]. Similarly, White et al reported that SLT causes transient corneal endothelial changes in most patients that have no impact on cell count or visual acuity [23]. In a recent study, Lee et al investigated the corneal changes after SLT and determined transient reductions in endothelial cell count and CCT following SLT returned to baseline levels 1 month after the procedure [8]. Similarly, Song et al reported a case with residual corneal thinning and flattening one year after SLT [24]. In 3rd month follow up after SLT; we have determined a minor but a statistically significant decrease in CCT. As cornea forms the upper border of the ACA, this thinning may alter the ACA. However, we did not find any significant alteration on ACA. The corneal effects of SLT should be confirmed with larger prospective studies.

To the best of our knowledge, there is not any data in the literature about the effects of SLT on ACA. Although anterior chamber angle widening is usually obvious after peripheral laser iridotomy which is used for controlling IOP in primary angle closure glaucoma, there are recent reports about the relevance of this observation with a quantitative method i.e. SCT [25, 26]. Additionally, there are some studies about the effects of trabeculectomy, another technique of glaucoma treatment, on ACA. Man et al documented the anatomical effects of clear lens extraction by phacoemulsification versus trabeculectomy on anterior ACA in patients with PACG and reported that compared to trabeculectomy, clear lens extraction resulted in an increase in ACA width and anterior chamber depth [27]. Hong et al evaluated the changes in angle anatomy in patients with PACG before and after trabeculectomy and reported that trabeculectomy results in a significant increase in the angle width [28]. In this study, we have evaluated the ACA alterations after SLT treatment and did not determine a significant alteration.

There are some limitations of this study that should be mentioned. First of all we did not evaluate the endothelial cell count which would be a marker of corneal changes in patients treated with SLT but requires some other equipment. Secondly, medications of patients were not stopped if necessary due to ethical reasons during the postoperative period and the effects of these medications on ACA were neglected.

Conclusion

ACA is a very important structure that should be preserved in ophthalmologic interventions if possible. In this study, we have determined that SLT did not result in any alterations on ACA in 3 months follow up which makes this technique favorable. Though a significant decrease in CCT was present, it was minor and SLT was successful in all patients in decreasing IOP. Larger, comparative studies are warranted to determine the corneal effects of treatment methods of glaucoma.

Disclosure of conflict of interest

None.

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