

The Long-Term Effect of Selective Laser Trabeculoplasty in Ocular Hypertension: A 3-Year Follow-Up Review

Baser G^{1*} and Karahan E²

¹Ozel Medifema Hospital Eye Clinic, Izmir, Turkey

² Van Education and Investigation Hospital Eye Clinic, Van, Turkey

***Corresponding author:** Gonen Baser, Ozel Medifema Hospital Eye Clinic, Izmir, 1429

Sok. No: 1/3 Alsancak-Izmir, Turkey, Tel: +90 532 2817848; E-mail: drgonenbaser@gmail.com

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Abstract

Purpose: To evaluate the long-term efficacy of selective laser trabeculoplasty (SLT) in patients with ocular hypertension (OHT)

Methods: This study is a retrospective chart review of patients with OHT, first diagnosis POAG without medication and uncontrolled POAG with maximum tolerated medical therapy who underwent SLT between July 2010 and July 2011. The aforementioned data were gathered from the 3-month, 6-month, 12-month, 24-month, and 36-month post operative visits. Three groups were compared regarding decrease in IOP, percentage of IOP decrease, and success rate after SLT treatment.

Results: The medical records of 46 eyes of 46 patients who underwent SLT treatment for OHT were reviewed. Mean age of the patients was 56.1±5.9. 21 were male and 25 were female. The overall success rate at the last visit at the 36th month was 42.9%.

Conclusion: The therapeutic effect in patients with OHT is moderate. The effect of SLT begins to decrease after one year. However, the repeatability and protecting of the ocular surface from the toxicity of the preservatives of anti-glaucoma drops are the main advantages of SLT. Thus, SLT may be considered as a first step therapy alternative in OHT under strict follow-up.

Keywords: Selective Laser Trabeculoplasty; Ocular Hypertension; Long-Term Results; Pachymetry; Gonioscopy; Fundoscopy

Abbreviations: SLT: Selective Laser Trabeculoplasty; OHT: ocular hypertension; POAG: Primary open angle glaucoma; IOP: Intraocular pressure; OAG: open-angle glaucoma; OHTS: Ocular Hypertension Treatment Study; ALT: Argon laser trabeculoplasty; SLT: selective laser trabeculoplasty; TM: trabecular meshwork

Introduction

Ocular hypertension (OHT) is a state of raised intraocular pressure (IOP) without optic nerve damage, which progresses to primary open-angle glaucoma (OAG) in some patients [1,2]. The progression rate from OHT to

OAG has been reported from 9.5% to 16.1% between 5-7 years [2]. Elevated IOP is a leading risk factor for the development of POAG and the only modifiable risk factor at present and it is estimated that 4% to 7% of the US population older than 40 years has OHT [3]. These patients are at higher risk of developing glaucoma than the general population and treating them is still controversial [3].

Prior to the Ocular Hypertension Treatment Study (OHTS), there was no clear, evidence-based consensus on the safety and efficacy of topical ocular hypotensive medication in delaying or preventing the onset of POAG [2,4]. The OHTS clearly demonstrated that topical ocular hypotensive treatment reduced the cumulative incidence of POAG by 50% to 60% in individuals with OHT. At 60 months of follow-up, the cumulative frequency of POAG was 4.4% in the medication group and 9.5% in the observation group [2]. This fact makes it important to maintain the stability of IOP in OHT.

The medical therapy of glaucoma lasts life-long. The adverse effects of topical medication and the obligation of daily application require serious collaboration between the physician and patient. Adherence to the medical therapy is a serious problem in glaucoma patients [5,6].

SLT is a method of non-invasive IOP reduction, which is first reported by Latina [7]. The device is a Q-switched, frequency-doubled Nd: YAG laser that is melanosome-specific and is widely used to lower IOP in patients with open-angle glaucoma or ocular hypertension. In contrast to ALT SLT works by selective targeting of pigmented trabecular mesh work with minimal structural damage. This makes SLT a repeatable therapy [8]. As SLT is a treatment alternative with relatively low side effects, we planned to evaluate the effectiveness of SLT in patients with OHT retrospectively in a long-term follow-up.

Subjects and Methods

This study is a retrospective chart review of patients with OHT, first diagnosis POAG and uncontrolled POAG with maximum tolerate medical therapy who had undergone SLT at the Sifa University between July 2010 and July 2011. The study adhered to the tenets of the Declaration of Helsinki. Informed patient consent and approval by the institutional review board were obtained prior to the study commencement. The authors declare no financial or proprietary interests.

The aforementioned data were gathered from the 3-month, 6-month, 12-month, 24-month, and 36-month postoperative visits. As part of routine clinical practice, a full ocular examination was performed for each newly referred patient, including best-corrected visual acuity, slit-lamp evaluation, Goldman applanation tonometry (We used in this study two initial IOP measures for each patient to reduce the effect of diurnal variation and improve accuracy), corneal pachymetry, gonioscopy, dilated funduscopy, visual field testing and imaging as appropriate.

Patients, who had an average intraocular pressure higher than 25 mm Hg, in at least 3 periodical measurements and no optic nerve damage or any visual field defects, were defined as OHT.

Patients with any type of glaucoma, pre-existing corneal pathology or scars, previous ALT or SLT treatment, defaulted follow-up, previous intraocular surgery, such as cataract, retinal detachment, glaucoma surgery, any previous uveitis or intraocular inflammation were excluded.

Visual Field Loss Progression Analysis

Visual function was assessed by Snellen visual acuity and visual field tests (Humphrey Field Analyzer (HFA) (Carl Zeiss Meditec, Dublin, CA, USA). The mean deviation (MD) index of a standard SITA 24-2 visual field was used as a measure of the overall visual field status. We used the data of MD values and the VF progression was defined as presence of significant negative MD decrease of more than 0.05 dB during the follow-up period.

SLT Technique

In the present study, the SLT treatment was performed over 360° of the trabecular meshwork (TM) with the SLT Lightmed Combi Laser® in two sessions. Approximately 50 spots were applied to the TM. The initial energy of the laser was 0.8 mJ. The energy was increased or decreased until bubble formation appeared. The energy used in the present study was between 0.5 and 1.0 mJ. No more laser energy was necessary to achieve the desired bubble formation. No medication was given to any patient who was treated with SLT, unless an anterior chamber reaction was detected after the treatment.

In this situation, Flourometolon eye drops were used twice in a day for a few days. All patients were initially treated by SLT over 180° in the lower part of the TM. The

second therapy was applied on the upper 180° part, one month later. All lasers were performed by the same surgeon. Success rates defined in terms of both a 20% or more IOP reduction from baseline measurements with no additional anti glaucomatous interventions. The IOPs were measured using a Goldman applanation tonometer by a different ophthalmologist, who was being blind to the patient group. The IOP was measured three times and an average value was calculated. Only right eyes were included in the study.

If an increase of 20% of the baseline IOP was observed after two SLT sessions, and a worsening in mean deviation (MD) decrease of more than 0.05 dB in the VF was detected during the follow-up period, the patient was accepted as “OHT converting to POAG” or “failure of the therapy”. In these patients medical therapy was initiated. If only an increase of IOP was detected without any VF defect, SLT was repeated or the patients were called to controls with lesser intervals.

Statistical Analysis

SPSS, statistical software, version 11.6 (SPSS, Inc, Chicago, IL) was used for statistical analysis. The differences between the IOP levels before and after SLT were compared with the paired t-test. A P-value of less

than 0.05 was considered as a statistically significant result.

Results

The medical records of 46 eyes of 46 patients who underwent SLT treatment for OHT were reviewed. The characteristics of the patients are shown in Table 1. Characteristics of the OHT patients

Age	56.1±5.9
Gender	21M /25 F
BCVA (log)	0.21±0.16
Number of spots per eye	102± 5.8

Table 1: Baseline characteristics of the patients.

M/F: Male/female

BCVA: Best corrected visual acuity

OHT: Ocular hypertension

The mean baseline IOP was 27.5±1.4 mmHg. The percentage of the decrease in IOP at last visit compared with baseline IOP was -18.6%±12.2 %. The peak decrease in IOP was achieved in the 12th month. After the first year, the IOP tended to rise. The overall IOP decrease was statistically significant in each control period (P<0.001, k P<0.001, P<0.001, P<0.001P<0.001, respectively, Table 2).

	Baseline	3 months	6 months	12 months	24 months	36 months
IOP changes (mmHg)	27.5±1.45	22.4±3.5*	22.2±3.3*	21.8±2.9*	22.3±3.5*	22.3±3.5*
Decrease in IOP (mmHg)		-5.1±3.4*	-5.4±3.5*	-5.9±3.4*	-5.4±3.9*	-5.2±3.9*
Success rates at all visits)		91.70%	77.80%	66.70%	52.80%	42.90%

Table 2: Results of the OHT patients

IOP: Intraocular pressure

OHT: Ocular Hypertension

*: P<0.05

Discussion

Treating OHT presents high controversy in ophthalmology clinics. It is not clear whether watchful waiting is the best public health approach for all patients with OHT. Studies have shown that patients often do not return for follow-up appointments and clinicians often do not order diagnostic tests at appropriate intervals [9]. This fact may lead to overlook the progression of OHT to POAG in patients. Another important question is, “when”

to begin to treat these patients with OHT. The slow progression of OHT to glaucoma leads to indecision in the ophthalmology clinics.

On the other hand, an initiation of glaucoma therapy means a life-long topical anti glaucoma medication for the OHT. This long-term therapy may lead to ocular surface problems and life discomfort in many patients [10,11]. Review of the literature showed that SLT is a viable option as a primary or adjuvant treatment for patients

with POAG, OHT, and pseudo exfoliation glaucoma [12-14]. The published success rate of SLT ranges from 65% to 100% in short term [15,16]. Success has been previously defined as an IOP reduction of 3 mm Hg or more or more commonly by an IOP reduction more than 20% [17,18]. In our series, the short term effect (3-12 months) of SLT was similar to the studies which were reported before (66.7 %-91.7%, respectively). The overall success rate of SLT after 3 years was 42.9%.

The main advantage of SLT over other anti glaucoma laser procedures such as Argon Laser Trabeculoplasty (ALT) is that its absence of coagulative damage (fibrosis and scarring) to the trabecular meshwork (TM) allows treatment to be repeated. Retrospective studies have looked at the efficacy of repeat SLT after failed primary SLT. Two studies showed that the repeat SLT treatment was at least as effective and may last longer than the initial treatment [19,20]. One study showed that not all eyes responding to primary SLT responded to repeat SLT [21]. The exact mechanism by which SLT lowers IOP remains incompletely understood. Suggested mechanisms are structural alterations of the TM without any coagulative damage which leads to optimizing the TM outflow architecture, altering transendothelial aqueous flow across Schlemm's canal cells due to intercellular junction changes in the endothelial cells of the Schlemm's canal by oxidative stress, and proliferative responses such as IL-1 β , and TNF α expression which may increase outflow facility by remodeling the juxtacanalicular extracellular matrix [22-24]. All these mechanisms are not related with severe side-effects, which makes SLT a repeatable intervention.

Our study has its limitations and strengths. The major limitation is the retrospective design. The other important point is the relatively low number of the subjects. This study would give more information if it would be a prospective study, compared with an untreated control group of OHT patients with a large patient group. Nevertheless, a long-term prospective study is not easy to sustain. Therefore our study can give us only limited information about the long-term effect of SLT in OHT patients. However, there is no much information about the effect of SLT in OHT in the literature. To our knowledge, our study is one of the few studies with such a long follow-up period in the literature.

In overall, we might say that, SLT is an effective method in patients with OHT in short term and the success rate was over 40% at 36 months after initial treatment. The advantage of SLT is to keep the IOP in a safe level without

any medication. Thus, the ocular surface is protected from preservative substances, such as benzalchonium chloride (BAC), or polyquad (PQ), which are used widely in anti-glaucoma drops.

Waisbourd et al suggested the SLT to consider as a first step treatment in OHT and POAG [25]. We agree with this idea. However, the effect of SLT decreases with time. Therefore, the patients who underwent SLT should be kept under strict control, because patients who underwent a surgical intervention tend to believe that their health problem is solved. This leads to disruption of their glaucoma controls. Giving detailed information about this procedure is here essential. The second aim of the studies in this field should be focused on investigating the increase of the long-term effect of SLT.

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