The influence of selective laser trabeculoplasty on the success of trabeculectomy

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Abstract:
PURPOSE: The purpose of this study is to investigate whether selective laser trabeculoplasty (SLT) has any effect on the success of trabeculectomy.

PATIENTS AND METHODS: Thirteen-one eyes of 29 primary open-angle glaucoma patients who underwent SLT before trabeculectomy and 29 eyes of 27 patients with the same inclusion criteria which underwent trabeculectomy without prior SLT in the Sifa University and in the Batıgöz Eye Hospital in January 2012 and November 2012 were reviewed. All patients underwent trabeculectomy for uncontrolled open-angle glaucoma with the same technique. The results were evaluated 3, 6, 12, 18, and 24 months later after surgery. The statistical analysis was performed with the Mann-Whitney U-test. Fisher’s Exact Chi-square test was used to compare the continuous and categorical variables.

RESULTS: The mean intraocular pressure (IOP) before surgery was 24.1 ± 1.9 in the SLT-performed group and 26.7 ± 1.6 in the non-SLT-performed group. Twenty-four months later, the mean IOP was 15.1 ± 1.2 in the SLT-performed group and 15.4 ± 1.4 in the non-SLT performed group. There was no difference in the IOP drop after trabeculectomy between the two groups (P = 0.531).

CONCLUSIONS: SLT has no influence on trabeculectomy success.

Keywords: Glaucoma surgery, primary open-angle glaucoma, selective laser trabeculoplasty, trabeculectomy

Introduction

Glaucoma is the second leading cause of blindness worldwide and constitutes a major global healthcare problem.[1] The only method to slow or stop progressive damage caused by glaucoma is lower intraocular pressure (IOP). Surgical modalities of treatment on the eye using various techniques to lower IOP have proven effective in some cases though with variable frequencies of success and various complications. Glaucoma surgery offers the great advantage of longer-term IOP control than medicinal treatments presently available and also of lessening the need of the patient’s adherence and compliance to antiglaucoma treatments.[2] Since it was introduced in 1968 by Cairns, trabeculectomy has remained the most common and effective surgical procedure for the treatment of glaucoma.[3]

Laser trabeculoplasty involves the delivery of electromagnetic energy to the trabecular meshwork to enhance aqueous drainage and lower IOP.[4] Laser trabeculoplasty is most commonly performed with either argon (wavelength, 488-514 nm; which is known as argon laser trabeculoplasty [ALT]) or Q-switched, frequency-doubled neodymium–yttrium-aluminum-garnet (Nd: YAG; wavelength, 532 nm; also known as selective laser trabeculoplasty [SLT]) lasers. In direct comparisons, similar treatment areas of ALT and SLT have been shown

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to be equivalent with regard to IOP lowering.\cite{5,6} Laser procedures are accepted as adjuvant therapies or first step treatments in selected cases to lower the IOP.\cite{7}

There may be some factors which can influence the final success of trabeculectomy.\cite{8,9} The main factor may be the inflammatory response of the eye to the surgery, which may be influenced by surgical trauma and/or previous medication or previous inflammation. While Ayala et al. reported a very minimal and temporary effect of SLT,\cite{10} relatively severe reponses have been reported by Koktekir et al.\cite{11} Whether these alterations might have any effect on bleb failure remains unknown.

As surgical treatments are feared or not accepted by some patients as first-line therapies, therefore, laser procedures such as SLT is offered as a final intervention before resorting to more invasive surgical therapies. In this study, we planned to evaluate the outcomes in patients in which we performed SLT before trabeculectomy, to determine whether SLT has any influence on the trabeculectomy outcomes in these patients.

**Patients and Methods**

This was a retrospective, comparative cohort outcome study with a follow-up time of 24 months. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Routine written informed consent was obtained from all individual participants before the operation that their medical and surgical data can be used for future scientific purposes.

Thirty-one eyes of 29 patients who underwent SLT before trabeculectomy in the Sifa University and in the Batıgöz Eye Hospital in January 2012 and November 2012 were reviewed and were identified through surgical logbooks and a subsequent case note-review. Twenty-nine eyes of 27 patients with the same inclusion criteria which underwent trabeculectomy without prior SLT were considered as control group. All patients had a fixed antiglaucoma (PGE2 analog, topical beta-blocker, and brimonidine/dorzolamide) therapy regimen with a maximum tolerated medical therapy and had a mean IOP over 22 mm Hg before SLT. The visual field examinations demonstrated slow progression in the last year. All patients were phakic and had primary open-angle glaucoma (POAG). All patients underwent SLT (360°) on the iridocorneal angle in two different sessions. A decrease of the mean IOP of more than 20% or under 18 mm Hg after SLT was observed in the follow-up period. When we observed an increase over 20 mm Hg after SLT, the patients were considered for surgery.

**Visual-field analysis**

Visual-field tests Humphrey field analyzer (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.

Exclusion criteria included patients with secondary open-angle glaucomas such as pseudoexfoliation glaucoma pigmentary glaucoma, uveitic glaucoma as well as angle closure glaucomas, patients undergoing redo-trabeculectomy surgery or trabeculectomy combined with another intraocular surgical procedure and any patient with notes unavailable were to be excluded from the study.

**Surgical technique**

A limbus-based conjunctival flap was created at one of the superior quadrants. A 4 mm × 4 mm triangular, one-half scleral thickness scleral flap was dissected, extending into the clear cornea. Subconjunctival 50 mg of 5-FU was applied for 3 min with a wide application area in all cases. Following removal of the sponge, the site was irrigated copiously with balanced saline solution. The other eyes did not receive any adjuvant therapy during surgery. After trabeculectomy, peripheral iridectomy was performed. The flap was closed with three 10–0 nylon sutures. Conjunctiva was reapproximated with 8–0 vicryl sutures.

Postoperatively, topical cyclopentolate 1%, dexamethasone 1%, and moxifloxacin 0.3% were given for at least 6 weeks. Antiglaucoma medications were discontinued immediately after surgery. The SLTs were performed by Dr. UÜ, and the trabeculectomies were performed by Dr. GB.

The results were compared with patients who underwent trabeculectomy in the same period without any prior laser therapy for POAG.

**Statistical analysis**

Statistical analyses were performed using the Rstudio software version 0.98.501 via R language (Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand). The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov–Smirnov/Shapiro–Wilk test) to determine whether or not they were normally distrubuted. Descriptive analyses were presented.
Results

The mean age of the patients who underwent SLT before surgery was 60.8 ± 5.7 (52–72). Fifteen were female (51.72%), and 14 (48.28%) were male. There was no difference between the age and gender of the groups (P = 0.315). In the postoperative period, we observed hypotony in two eyes, hypertony in two eyes, and bleb encapsulation in one eye. These complications were treated with conventional methods. No further surgical intervention was necessary. The mean period of surgery after SLT was 6–16 (Mean 11.4 ± 3.2) months. The mean age of the patients who did not undergo SLT before surgery was 58.0 ± 7.4 (49–73). Fifteen were female (55.55%), and 12 were male (44.45%). In the postoperative period, we observed hypotony in three eyes, hypertony in one eye, and bleb encapsulation in one eye. These complications were treated with conventional methods. No further surgery was necessary also. No cataract or retinal detachment developed in both groups during the follow-up period. There was no statistical significance between the complication ratios between the both groups (P = 1.00). The mean period of surgery after the decision to undergo it was 1–4 months.

The mean IOP course of both groups is summarized in Table 1. There was no statistical significance between the IOP values in the follow-up period except the 12th month values (P = 0.043).

Table 1: Comparison of intraocular pressure post trabeculectomy in uncontrolled primary open-angle glaucoma patients: Prior selective laser trabeculoplasty (SLT) and no prior selective laser trabeculoplasty (SLT−)

| Group                | n  | Mean IOP (mmHg) | P     |
|----------------------|----|-----------------|-------|
| IOP preoperative     |    |                 |       |
| SLT+                 | 31 | 24.1 ± 1.9      | 0.0001* |
| SLT−                 | 29 | 26.7 ± 1.6      |       |
| IOP 3 months later   |    |                 |       |
| SLT+                 | 31 | 15.3 ± 1.6      | 0.633 |
| SLT−                 | 29 | 14.9 ± 2.1      |       |
| IOP 6 months later   |    |                 |       |
| SLT+                 | 31 | 14.4 ± 1.4      | 0.911 |
| SLT−                 | 29 | 14.5 ± 1.8      |       |
| IOP 12 months later  |    |                 |       |
| SLT+                 | 31 | 15.0 ± 1.4      | 0.0043* |
| SLT−                 | 29 | 13.7 ± 2.2      |       |
| IOP 18 months later  |    |                 |       |
| SLT+                 | 31 | 15.0 ± 1.5      | 0.596 |
| SLT−                 | 29 | 15.5 ± 1.7      |       |
| IOP 24 months later  |    |                 |       |
| SLT+                 | 31 | 15.1 ± 1.2      | 0.531 |
| SLT−                 | 29 | 15.4 ± 1.4      |       |

*P < 0.05, statistically significant. SLT: Selective laser trabeculoplasty, IOP: Intraocular pressure

Discussion

This study contributes to the hypothesis that SLT does not affect the surgical success of trabeculectomy. Trabeculectomy is still considered the gold standard for medically uncontrolled glaucoma. However, it is accompanied by the highest risk of severe complications. Before resorting to operation, patients undergo various therapies such as medical therapy or laser interventions. The possibility exists that these therapies can influence the success rates of trabeculectomy.[12] We do not know the extent of spread of the inflammatory response caused by laser trabeculoplasties or their exact duration of effect.[13] Although we are bypassing the eye’s conventional outflow mechanism after trabeculectomy, these differences might cause different outcomes. We do not know, how wide the inflammatory response spreads and lasts caused by laser interventions. As we theoretically know that the inflammation after SLT is low, we may assume that it should have no influence on the success of trabeculectomy.

The effect of ALT on trabeculectomy success has been reported in various studies. While Schoenleber et al. recognized no difference in the response to filtration surgery following ALT,[14] Khalili et al. reported a significant lower success rate in patients with prior ALT.[15] The results of the effect of SLT before various surgical interventions in POAG are scarcely reported in the literature. Klamann et al. reported in a recent study that prior SLT treatment seems not to negatively influence combined clear cornea phacoemulsification and Trabectome outcomes in glaucoma patients in the first 6 months. Interestingly, they postulated that SLT treatment may have a positive impact on combined Trabectome outcomes in patients with pseudoexfoliative glaucoma (PEX) and pigmentary glaucoma (PG) also. Although the outcomes in patients with PEX and PG remains unclear, PG and PEX are often associated with increased pigmentation of the trabecular meshwork. In ALT treatment, a greater IOP reduction in PEX than in POAG is probably due to the greater degree of pigmentation. However, angle pigmentation was not found to be a predictive factor of success in SLT treatment. The 360° SLT treatment alone may improve the outflow pathways of the whole trabecular meshwork in patients with PEX and PG. In addition, the Trabectome Study Group found that Trabectome surgery does not appear to be negatively affected by laser trabeculoplasty also.[16,17]
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Selective laser trabeculoplasty versus argon laser trabeculoplasty in medically-uncontrolled POAG patients during the first 2 years of postoperative follow-up. This retrospective cohort study demonstrated that SLT does not affect the success of trabeculectomy surgery in POAG patients, [23] prior ALT had no effect on the outcome of trabeculectomy. [19-21]

The results of our study demonstrate that prior SLT does not have any influence on the success of trabeculectomy. On the other hand, SLT may keep the IOP low for a period of a few months. This gives us the advantage in the cases in which trabeculectomy must be delayed due to the surgery anxiety of the patients or other reasons. The patients could be convinced to the surgery and the systemic problems such as regulation of blood sugar or hypertension, which are common in the middle-age and elderly patients, could be stabilized until surgery.

Our study is limited by its retrospective design. The sample size is small. Larger, prospective studies are needed to confirm our findings. Another important point is that this study only looked at a single outcome measure of success that being IOP. It did not include for example number of glaucoma medications postoperative. Other limitations are that the study only focused on the POAG subset of patients. Perhaps results would have been different with inclusion of pseudoexfoliative and pigmentary glaucomas. The low patient number did not allow to divide the patients into different groups. An additional limitation is the lack of unified timing of SLT in relation to trabeculectomy. Since it is a known fact that with SLT, there is attenuation in the efficacy of laser over time. Therefore, with variable time intervals between pre-SLT and trabeculectomy surgery, there is a possibility that SLT effects obviously have weaned off and this makes the exposed group (pre-SLT) similar to the control group (no pre-SLT).

Nevertheless, to the best of our knowledge, this is the first study that investigated the effects of SLT on trabeculectomy success.

**Conclusion**

This retrospective cohort study demonstrated that SLT does not affect the success of trabeculectomy surgery in medically-uncontrolled POAG patients during the first 2 years of postoperative follow-up.

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**Conflicts of interest**

There are no conflicts of interest.

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