

Selective Laser Trabeculoplasty in the treatment of Glaucoma: from eight to eighty

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RESUMO

Objetivo: Avaliar a eficácia da trabeculoplastia laser seletiva (SLT) em olhos com glaucoma de ângulo aberto (OAG) em estadio inicial e avançado.

Material e métodos: Revisão retrospectiva dos doentes submetidos a SLT no nosso hospital com um período de seguimento de 6 meses. A SLT foi realizada em olhos com OAG primário ou pseudoesfoliativo. As indicações para o procedimento foram o controlo insuficiente da pressão intraocular (PIO) ou a má *compliance* com o tratamento médico. Foram obtidos os registos da PIO antes do procedimento, 2 semanas, 2 e 6 meses após o tratamento com laser. Foram considerados como critérios de sucesso no grupo de glaucoma inicial a redução da PIO <21 mmHg e >20% relativamente à PIO inicial, e no glaucoma avançado a redução da PIO <18 mmHg e >20% relativamente ao valor inicial.

Resultados: Foram incluídos neste estudo 34 doentes (44 olhos). No grupo com glaucoma inicial foi observada uma redução média da PIO de -7.46 mmHg ($p < 0.001$) e taxa de sucesso de 76.9% aos 6 meses. No grupo com glaucoma avançado foi observada uma redução média da PIO de -5.30 mmHg ($p < 0.001$) e taxa de sucesso de 78.9% aos 6 meses após o procedimento. Não houve registo de qualquer complicação associada à realização de SLT.

Conclusões: Aos 6 meses a SLT revelou-se um procedimento eficaz no tratamento de olhos com OAG em estadio inicial e avançado.

Palavras-chave: Trabeculoplastia laser seletiva, glaucoma ângulo aberto, glaucoma avançado, pressão intraocular, eficácia

ABSTRACT

Purpose: To evaluate the efficacy of selective laser trabeculoplasty (SLT) in eyes with open-angle glaucoma (OAG) in early and advanced stage.

Material and methods: Retrospective review of patients treated with SLT in our hospital with a follow-up time of 6 months. SLT was performed in eyes with primary or pseudoexfoliation OAG. Indications for the procedure were insufficient intraocular pressure (IOP) control or poor compliance to medical treatment. IOP records were obtained preoperatively, 2 weeks, 2 and 6 months after laser treatment. Success criteria were defined as a reduction of IOP <21 mmHg and > 20% of the initial IOP in early glaucoma group, and for the advanced glaucoma group as a reduction of IOP <18 mmHg and > 20% from baseline.

Results: Forty-four eyes from 34 patients were included in the study. In the early glaucoma group, it was observed a mean IOP reduction of -7.46 mmHg ($p < 0.001$) and a success rate of 76.9% at 6 months. In the advanced glaucoma group, it was observed a mean IOP reduction of -5.30 mmHg ($p < 0.001$) and a success rate of 78.9% at 6 months after SLT. There were no reports of complications associated with SLT.

Conclusions: At 6 months, SLT seems to be an effective procedure in the treatment of eyes with OAG in early and advanced stage.

Keywords: Selective laser trabeculoplasty, open angle glaucoma, advanced glaucoma, intraocular pressure, efficacy

INTRODUCTION

Glaucoma is a leading cause of irreversible blindness around the world. Although it is a multifactorial disease, elevated intraocular pressure (IOP) is the major risk factor for the development and progression of glaucoma, and it is the only modifiable risk factor¹⁸. Currently there are three methods available to reduce IOP: medical treatment, laser treatment, and surgery²⁶. The treatment options are based upon the type of glaucoma, the degree of optic nerve damage, patient's symptoms and compliance with IOP-lowering medications¹.

Eye drops are typically the first line therapy for glaucoma. However, topical agents and preservatives in glaucoma medication can produce local and systemic side effects⁶. Adherence can also pose a problem¹⁵. Administering topical medications is also often problematic for elderly patients who need assistance to administer the

drops or miss the eye and waste expensive medication²⁵.

The risks of filtering surgery are also well recognized, including the possible functional deterioration in patients with advanced glaucoma (wipe-out syndrome)¹⁰. Furthermore, there is an increasing number of older glaucoma patients with a range of systemic diseases and medications, sometimes with cognitive limitations or complicated life circumstances, which can delay the indication and performance of filtering surgery.

Argon laser trabeculoplasty (ALT), introduced in 1979 by Wise and Witter, rapidly became a standard therapeutic option in the clinical management of open-angle glaucoma (OAG), and has been used for more than 30 years^{19, 20}. The five-year success rate with ALT is reported to be 50%, with a decrease of 6% to 10% per year¹⁷. However, ALT has been observed to produce some deleterious effects to the microstructure of the trabecular meshwork (TM) which may limit retreatment with ALT.

Selective laser trabeculoplasty (SLT) was developed by Latina and Park in 1995 and provided a new therapeutic option for OAG treatment¹⁴. This method is performed with a 532-nm Nd:YAG laser, and targets the pigmented cells of the TM without causing thermal or collateral damage to the surrounding structures⁹. SLT was reported to be effective in lowering IOP by 11% to 40% in OAG or ocular hypertension (OHT) patients and has been shown to produce IOP lowering similar to ALT^{4, 11, 26}.

Comparing to ALT, the major advantage of SLT is the possibility of re-treatment because it doesn't produce any TM damage as in ALT procedure, thus allowing a second laser intervention in cases with previously failed trabeculoplasty²². SLT can be used in primary open angle glaucoma (POAG), pseudoexfoliative/pigmentary glaucoma, normal tension glaucoma and OHT. Moreover, SLT can be useful in cases of non-compliance or intolerance to topical IOP-lowering medications, and it also doesn't influence any surgical procedure regarding its potential success²¹. A great number of studies show that it is a safe procedure with a low complication rate. Possible complications include a transitory inflammatory reaction, ocular pain or an IOP spike after treatment³.

A synthesis of previous data suggests that SLT is effective at every stage of treatment for OAG. SLT can be used as a first-line therapy, alternative to medical therapy with a comparable efficacy, or as an adjunctive therapy for patients not controlled with maximally tolerated medication, before invasive surgery^{5, 12, 13, 16}. However, there were few reports in patients with advanced glaucoma^{2, 21}.

The aim of this study was to investigate the efficacy of SLT in patients with early and advanced OAG.

MATERIAL AND METHODS

This was a retrospective chart review of patients treated with SLT with a minimum follow-up time of 6 months, at the Department of Ophthalmology of Hospital Pedro Hispano (Matosinhos, Portugal) since October 2015 to August 2016. The methodology of the study was designed in accordance with the tenets of the Helsinki Declaration.

SLT was performed in patients with POAG or pseudoexfoliation glaucoma (PEXG). Indications for SLT treatment were insufficient IOP control or non-compliance to topical treatment.

Data recorded from each patient included age, sex, type

and stage of glaucoma, number of IOP-lowering medications, and the SLT protocol performed.

Glaucoma type was defined by gonioscopy and slit-lamp examination, and glaucoma stage through visual field (Humphrey visual field analyser) according to the *Hodapp-Parrish-Anderson's* criteria⁷.

In our study the laser procedure was performed on 360 degrees (100 laser spots) and by a single surgeon (R.B.). Before the laser procedure, pilocarpine and topical anesthetic were instilled into the eye. The energy level was initially set at 0.7 mJ and adapted according to the grade of angle pigmentation and bubble formation. Postoperatively, the patients were prescribed topical non-steroidal anti-inflammatory eye drops 4 times a day during 1 week. The IOP-lowering medications were not changed or discontinued after SLT. Any symptoms of ocular complications were recorded.

IOP was measured preoperatively, at the end of the second week, then approximately 2 and 6 months after laser treatment. All IOP measurements were performed with Goldmann applanation tonometry.

Success criteria were defined as: a reduction of IOP <21 mmHg and >20% of the initial IOP for the early glaucoma group; a reduction of IOP <18 mmHg (according to Advanced Glaucoma Intervention Study)²⁴ and >20 % of the baseline IOP for the advanced glaucoma group.

Statistical analysis was performed using SPSS (Version 21.0, SPSS Inc., Chicago, IL, USA). Continuous variables were described as mean and standard deviation (SD). Shapiro-Wilk test was used to test for normality. Independent samples t-test was used to compare means between early and advanced glaucoma groups and means between different types of glaucoma. Paired samples t-test was used to compare measurements before and after treatment with SLT, including mean IOP values and mean number of IOP-lowering medications. A value of $p < 0.05$ was considered to be statistically significant.

RESULTS

Forty-four eyes from 34 patients submitted to SLT were included in the study. The patients' demographics and glaucoma characteristics are shown in Table 1.

Table 1 - Baseline characteristics of the patients included in the study

	Early glaucoma stage group	Advanced glaucoma stage group	t-test
Number of eyes/patients	21/15	23/19	
Mean age ± SD	69.60±10.41	76.47±8.26	p = 0.039
Gender (male: female)	8:7	14:5	
Eye (OD: OS)	10:11	15:8	
Mean baseline IOP ± SD (mmHg)	23.0±3.46	20.09±2.13	p = 0.002
Type of glaucoma			
- POAG	14	16	
- PEXG	7	7	
Topical medication (average number of drugs ± SD)	1.38±0.92	2.74±0.81	p < 0.001

Baseline IOP was significantly higher in the early glaucoma group compared with the advanced glaucoma group (23.0±3.46 vs 20.09±2.13, p= 0.002).

Overall a significant mean IOP reduction was achieved in both groups after SLT procedure and maintained over the 6 months of follow-up (Table 2).

Table 2 - Effect of SLT on intraocular pressure

	Early glaucoma stage group	t-test	Advanced glaucoma stage group	t-test
	Mean IOP±SD (mmHg)		Mean IOP±SD (mmHg)	
Baseline	23.00±3.46		20.09±2.13	
After 2 weeks	17.69±2.68	p<0.001	15.80±2.31	p<0.001
After 2 months	17.20±2.86	p<0.001	14.75±3.11	p<0.001
After 6 months	15.54±3.13	p<0.001	14.79±2.49	p<0.001

In the early glaucoma group, it was observed a mean IOP reduction of -7.46 mmHg (p<0.001) with a success rate of 76.9% at 6 months of follow-up.

The advanced glaucoma group had a mean IOP reduction of -5.30 mmHg (p<0.001) with a success rate of 78.9% at 6 months of follow-up.

Eyes with PEXG showed a reduction rate of IOP similar to those with POAG during the follow-up time (-7.04 vs -6.08 mmHg, p= 0.078).

Mean number of IOP-lowering medications remained unchanged after laser treatment for both groups.

SLT was well tolerated in all treated eyes, and no side effects were described in the charts.

DISCUSSION

SLT efficacy in OAG was already described. Success rates after 1 year ranged from 59 to 96% with an average

reduction in IOP from 7 to 40%^{26, 27}.

SLT may be used as initial therapy in OAG and OHT with the same efficacy in comparison to a pharmacological monotherapy⁸. Nevertheless, the efficacy of SLT in the advanced glaucoma was only been reported in a few studies²¹. SLT does not seem to be appropriate for advanced glaucoma with signs of progression because of the insufficient IOP reduction achieved. In these cases, filtering surgery remains the *gold standard*. However, in our opinion, SLT may have a place in the spectrum of treatment options for advanced OAG and moderate IOP elevation because it is fast, effective, safe, and cost- and time-saving procedure. This is even more important if we take into account the increasing global prevalence of glaucoma, which includes an increase in the number of older glaucoma patients with co-existing systemic diseases or medication which renders filtering surgery difficult and potentially dangerous²³.

So, we conducted this study in order to compare the efficacy of SLT in patients with early and advanced OAG.

Six months after treatment with SLT, despite the higher mean baseline IOP in the early glaucoma group, we found a significant IOP reduction with a success rate of nearly 80% in both early and advanced glaucoma groups (the latter using tighter criteria of success according to the Advanced Glaucoma Intervention Study). The rate of IOP reduction was sustained from 2 weeks to 6 months after laser treatment. There was no significant difference in IOP reduction between the 2 types of glaucoma (POAG and PEXG). There were no reports of side effects.

Our study is limited by its retrospective design and by the small number of patients included. Furthermore, the duration of observation was only 6 months after SLT. A longer period of observation would provide an even stronger evidence for clinical application of the results into daily practice.

In conclusion, the present study shows that SLT represents an effective procedure for lowering IOP in early and advanced stages of OAG. Further long-term prospective studies on a larger subject population are needed to confirm these results.

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