Efficacy of selective laser trabeculoplasty versus latanoprost as initial management in glaucoma

Eficácia da trabeculoplastia seletiva a laser *versus* latanoprosta como tratamento inicial no glaucoma

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ABSTRACT

Objective: To compare the hypotensive effect of SLT vs the use of latanoprost in the initial management of patients with suspected glaucoma and diagnosis of glaucoma. To evaluate the patients' quality of life using the Glaucoma Quality of Life questionnaire.

Methods: Randomized controlled clinical trial conducted in the city of Cartagena, Colombia, between October 2021 to June 2023. Assignment to the SLT or latanoprost group with follow-up at days 7, 30, 90, 180, and 365 in patients diagnosed with suspected glaucoma, mild and moderate glaucoma.

Results: 31 patients (60 eyes), of which 17 were men. Group SLT were 31 eyes and the latanoprost group included 29 eyes. The mean baseline IOP of the SLT group was 18.9mmHg and in the latanoprost group, it was 19.6mmHg. The mean IOP at the end of the follow-up group SLT was 13.9mmHg and for latanoprost 14.5mmHg. The IOP reduction percentage at one year of follow-up in the SLT group was 23.4% and that of the latanoprost group was 23.6%

Conclusions: Selective laser trabeculoplasty with Nd-YAG laser is as effective as the use of prostaglandin analogues as initial treatment in the early stages of glaucoma. Regarding the quality of life scale, although there were no statistically significant differences in both groups, the SLT showed an increase in the difficulty perceived by the patient for activities that involve peripheral vision, which is the most affected in patients with glaucoma.

RESUMO

Objetivo: Comparar o efeito hipotensor da trabeculoplastia seletiva a *laser versus* o uso de latanoprosta no tratamento inicial de pacientes com suspeita de glaucoma e diagnóstico de glaucoma; avaliar a qualidade de vida dos pacientes por meio do *Glaucoma Quality of Life Survey*.

Métodos: Ensaio clínico randomizado controlado realizado na cidade de Cartagena, Colômbia, entre outubro de 2021 e junho de 2023. Atribuição ao grupo trabeculoplastia seletiva a *laser* ou latanoprosta com acompanhamento nos dias 7, 30, 90, 180 e 365 em pacientes diagnosticados com suspeita de glaucoma, glaucoma leve e moderado.

Resultados: Foram incluídos 31 pacientes (60 olhos), sendo 17 homens. No Grupo Trabeculoplastia Seletiva a *Laser*, foram 31 olhos, e, no Grupo Latanoprosta, 29 olhos. A pressão intraocular basal média do Grupo Trabeculoplastia Seletiva a *Laser* foi de 18,9mmHg e, no Grupo Latanoprosta, foi de 19,6mmHg. A pressão intraocular média no fim do grupo de acompanhamento trabeculoplastia seletiva a *laser* foi de 13,9mmHg e para latanoprosta de 14,5mmHg. A percentagem de redução da pressão intraocular em 1 ano de acompanhamento no Grupo Trabeculoplastia Seletiva a *Laser* foi de 23,4% e a do Grupo Latanoprosta foi de 23,6%.

Conclusões: A trabeculoplastia seletiva a *laser* com Nd-YAG é tão eficaz quanto o uso de análogos de prostaglandinas como tratamento nas fases iniciais do glaucoma. Em relação à escala de qualidade de vida, embora não tenha havido diferenças estatisticamente significativas em ambos os grupos, a A trabeculoplastia seletiva a *laser* mostrou aumento na dificuldade percebida pelo paciente para atividades que envolvem a visão periférica, que é a mais afetada em pacientes com glaucoma.

INTRODUCTION

Glaucoma comprises a group of optic neuropathies characterized by progressive and irreversible degeneration of the nerve fiber layer and its axons with a consequent decrease or loss of the visual field.[1] It is the leading cause of irreversible blindness worldwide and, according to the World Health Organization (WHO), there are currently 76 million people suffering from this disease.[2]

High intraocular pressure (IOP) is the main risk factor for developing glaucoma and is the only one that can be modified.[3] The mainstay in the management of glaucoma patients is the reduction of IOP and the management of fluctuations, which prevents disease progression.

Several multicenter clinical trials have shown that lowering IOP prevents the development or delays the progression of glaucoma.[1] The Ocular Hypertension Treatment Study conducted by Kass et al. is a study that compared initiation of treatment *versus* no treatment in patients with ocular hypertension that showed at 5 years follow-up that 4.4% of patients in the medication group and 9.5% in the untreated group developed signs of glaucoma.[4]

Internationally, there is a broad classification to determine the type of glaucoma depending on whether the angle is open or closed on gonioscopy, which can be classified as primary open-angle glaucoma (POAG) with a prevalence of 74% and primary angle-closure glaucoma (PCAG) with a prevalence of 26%.[5]

The most widely used classification to assess severity is the one proposed by Hodapp, Parrish, and Anderson based on the mean deviation of Humphrey's campimetry.[6]

According to the American Academy of Ophthalmology, a patient with suspected glaucoma is defined as an individual who presents clinical characteristics or several risk factors for developing POAG: primary open-angle glaucoma. One of its variants is ocular hypertension, when an individual presents an IOP greater than 21mmHg without alterations in the visual field and evidence of structural damage. It may be a precursor for the development of glaucoma, and sometimes may require management to lower the IOP and thus prevent the development of glaucoma.[7]

The treatment of patients with glaucoma depends on its etiology and severity. The treatments used today include medical management, laser procedures, micro-invasive procedures, and conventional surgery.[3] All of them have the same objective: to lower IOP to avoid further damage to the nerve fiber layer of the optic nerve.

For many years, the first-choice treatment for glaucoma management was prostaglandin analogues and beta-blockers, but in recent years, with the advent of selective laser trabeculoplasty (SLT), which has demonstrated efficacy in IOP control, it has gained a place as initial treatment, even to the point of being considered first-line therapy today, as well as prostaglandin analogues.

The LiGTH study demonstrated that both therapies, SLT and prostaglandin analogues, showed similar efficacy in lowering IOP in patients with a diagnosis of ocular hypertension and GPAA at 3 years of follow-up.[8]

Selective laser trabeculoplasty is nowadays considered one of the treatments of choice in GPAA. It can also play a role as an adjunct to pharmacological therapy and in those patients with poor adherence to medical treatment or intolerance to them.[9]

As widely known, glaucoma is a disease that affects the patient's quality of life, including that of the surrounding family, in which daily life activities involving central vision, peripheral vision, glare, adaptation to darkness, and outdoor mobility are often affected.[10,11]

For all these reasons, the purpose of this study was to compare the hypotensive effect of SLT *versus* the use of latanoprost (prostaglandin analogues) in the initial management of patients with suspected glaucoma and with a diagnosis of mild or moderate glaucoma. In addition, we aimed at evaluating the quality of life of patients undergoing one of these 2 therapies using the Glaucoma Quality of Life Survey (GQL-15) questionnaire.

METHODS

This randomized controlled clinical trial was conducted in an ophthalmology clinic in Cartagena de Indias, Colombia, between October 2021 and June 2023.

We adhered to the ethical principles of the Declaration of Helsinki, received approval from the institutional ethics committee file number OFT2022II1B, and all participants signed an informed consent before the start of the study.

Patients who met the following inclusion criteria were included: diagnosis of suspected high-risk glaucoma, mild and moderate POAG. We excluded those patients who had an angle less than or equal to two according to the Shaffer classification, advanced glaucoma, secondary glaucoma, patients with any type of previous glaucoma surgery, any contraindication for SLT or the use of prostaglandin analogues.

Randomization of patients was performed with the epidat 4.0 program, and they were divided into two groups, Group 1 patients undergoing SLT therapy and

Group 2 patients receiving pharmacological treatment with latanoprost. Data were obtained directly from the study subjects from baseline and monitored at days 7, 30, 90, 90, 180, and 365 after initiation of treatment.

Selective laser trabeculoplasty therapy was performed with the equipment Solutis (SLT-laser) produced by Quantel Medical (Cournon d'Auvergne, France). The patients in Group 1 who underwent SLT had the protocol applied, which was performed by the same glaucoma specialist using these parameters in all patients: extension of 360º; spot of 400µ; run time of 0.03 msec, initial power of 0.8mJ (go titling according to tissue response with visualization of champagne bubbles). Power readjustment: 0.1mJ according to response (minimum 0.6mJ to maximum 1.2mJ). A maximum number of shots: 100 (25 per quadrant). Patients assigned to Group 2, in which latanoprost was used, started the intervention with the application of one drop at night (9 p.m.) in both or one eye (as appropriate).

In both groups, target IOP was considered according to the severity of the patient's damage as follows: mild glaucoma, 14 to 16mmHg, moderate, 12 to 14mmHg, and severe <12mmHg. If Group 1 failed to reach the target IOP, adjuvant treatment was started with one drop of latanoprost at night (9 p.m.) in the corresponding eye. On the other hand, if Group 2 failed to reach the target IOP, adjuvant treatment with SLT was started (Figure 1).

For patients in both groups, the GQL-15 was applied at baseline and the end of follow-up.

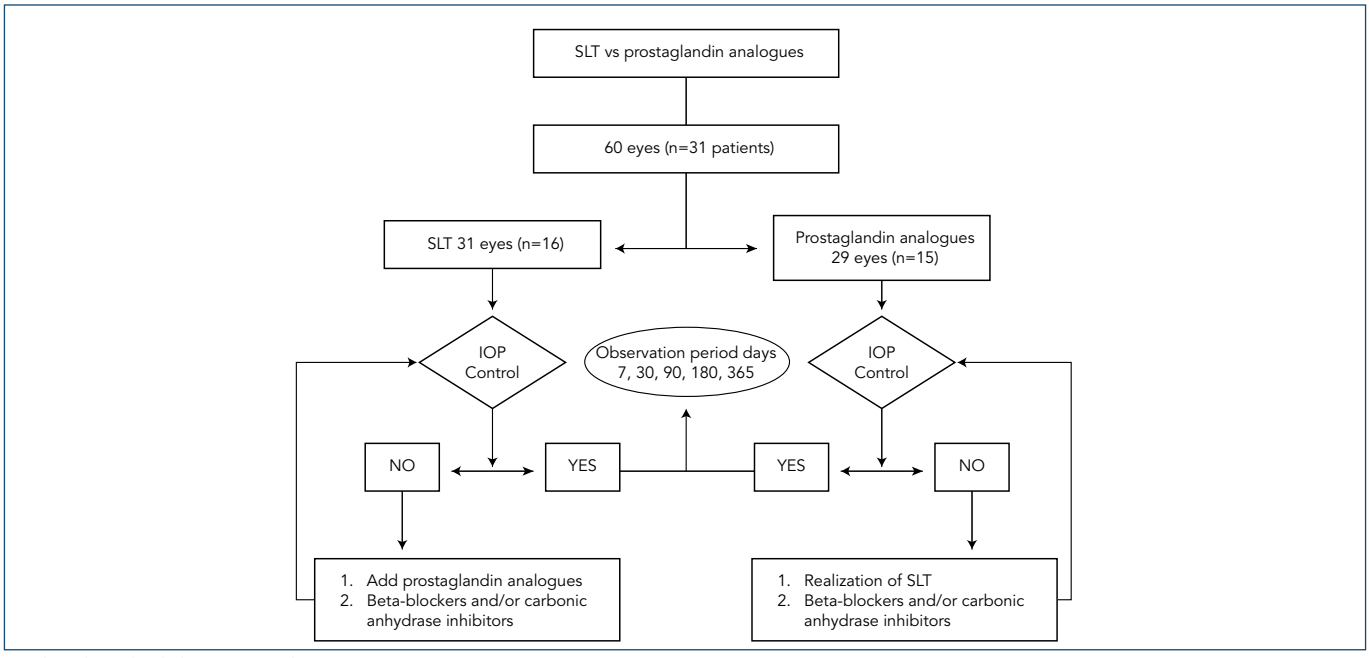
Statistical Analysis

The descriptive analysis of qualitative variables was performed by calculating absolute frequencies (n) and relative frequencies (%). Quantitative variables were analyzed using measures of central tendency such as average with their respective measures of dispersion such as standard deviation (SD). To compare the distribution of qualitative variables between the identified groups, X^2 or Fisher's exact test was used, as necessary. The T-student test was used to compare parametric quantitative variables and the Mann-Whitney U test was used to compare nonparametric variables between groups. The Wilcoxon test was used to compare intragroup parametric and nonparametric quantitative variables. A <0.05 p-value was considered statistically significant.

RESULTS

A total of 31 patients (60 eyes), 14 women, and 17 men were included. Of the 31 patients, 12 had a diagnosis of suspected high-risk glaucoma, 10 of mild glaucoma, and 9 of moderate glaucoma. The mean age of the studied sample was 62 years with a range between 32 to 82 years old. Thirty-one eyes were randomly assigned to the SLT group and 29 to the latanoprost group (Table 1).

The mean baseline IOP (before intervention) of the SLT group was 18.9mmHg (SD ±4.5) and that of the latanoprost group was 19.6mmHg (SD ±4.6). The mean IOP at the end of follow-up (1 year) for the SLT group was 13.9mmHg (SD) and for latanoprost was 14.5mmHg (Figure 2). The percentage of IOP reduction at 1-year follow-up in the SLT



SLT: selective laser trabeculoplasty; IOP: intraocular pressure.

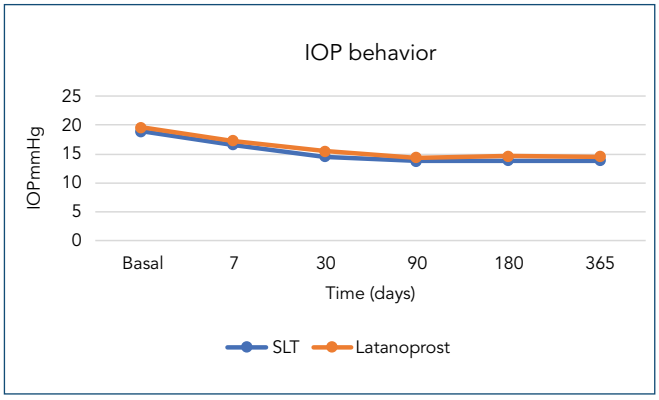
Figure 1. Patient management flowchart in the selective laser trabeculoplasty and latanoprost group.

Table 1. Characteristics of patients at baseline

	SLT n=31 (Eyes)	Latanoprost n=29 (Eyes)	p-value
Age ± SD	57.5±11.7	66.5±10.5	0.0320
Minimum-Maximum	32-74	52-82	
Number of patients	16	15	
Female n(%)	8 (50)	6 (40)	0.7223
Male n(%)	8 (50)	9 (60)	
Eye			0.9931
Right n(%)	15 (48.4)	14 (48.3)	
Left n(%)	16 (51.6)	15 (51.7)	
Diagnosis (n)			
Suspected glaucoma	6	6	
Mild glaucoma	5	5	
Moderate glaucoma	5	4	

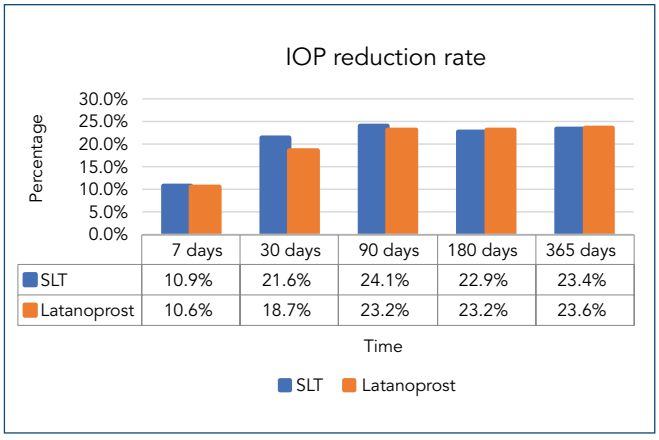
SLT: selective laser trabeculoplasty; SD: standard deviation

group was 23.4% (p<0.0001) and that of the latanoprost group was 23.6% (p<0.0001). When comparing the final IOP between the two groups, there was no statistically significant difference (Figure 3) (Table 2).



IOP: intraocular pressure; SLT: selective laser trabeculoplasty.

Figure 2. Intraocular pressure behavior at the patients evaluated.



IOP: intraocular pressure; SLT: selective laser trabeculoplasty.

Figure 3. Intraocular pressure reduction rate at the groups evaluated.

All patients with mild or moderate glaucoma met the target IOP established for damage at the end of follow-up. Two patients required additional interventions for failure

Table 2. The behavior of baseline intraocular pressure and percentage reduction in follow-up days

	SLT n=31 (Eyes)	Latanoprost n=29 (Eyes)	p-value*
IOP behavior (mmHg) ± SD			
Basal	18.9±4.5	19.6±4.6	0.5831
7 days	16.6±3.6†	17.3±4.0	0.4815
30 days	14.5±2.9†	15.5±2.6†	0.1605
90 days	13.8±1.7†	14.4±2.1†	0.1782
180 days	13.9±1.3†	14.6±2.1†	0.1822
365 days	13.9±1.5†	14.5±2.2†	0.2169
IOP reduction rate ±SD			
7 days	10.9%±12.2	10.6%±9.7	0.9239
30 days	21.6%±12.9	18.7%±12.4	0.3750
90 days	24.1%±16.1	23.2%±16.3	0.8275
180 days	22.9%±16.8	23.2%±13.8	0.9357
365 days	23.4%±16.6	23.6%±14.3	0.9582

SLT: selective laser trabeculoplasty; IOP: intraocular pressure; SD: standard deviation.
* p-value comparing groups; † p-value <0.05 compared to the baseline intraocular pressure of the same group.

to achieve the target IOP. One patient in the SLT group required the addition of latanoprost at 90 days after the initial intervention and one patient in the latanoprost group required SLT at 90 days; the same patient did not achieve IOP control at 180 days and a triconjugate was added. As for the results of the GQL-15 survey, at the time of application, the diagnosis each patient had at the time of admission to the study was considered for this evaluation. Patients belonging to the SLT and latanoprost group with a diagnosis of suspected glaucoma, mild glaucoma, and moderate glaucoma presented mild difficulty in the 4 aspects evaluated by this survey, both before the intervention and at 365 days. There was no statistically significant difference between and within groups (Table 3).

Table 3. Glaucoma Quality of Life Survey results at baseline and end of the study

Description	SLT		Latanoprost	
	Initial ±SD	Final ±SD	Initial ±SD	Final ±SD
Suspected glaucoma				
Central view	2.50±1.05	2.67±0.82	2.50±0.55	2.67±0.52
Peripheral vision	6.33±0.52	7.67±1.03*	7.83±2.14	8.17±2.32
Glare and adaptation to darkness	9.00±1.10	9.17±1.47	8.17±1.47	8.50±1.38
External mobility	1.00±0.00	1.17±0.41	1.17±0.41	1.33±0.52
Mild glaucoma				
Central view	2.40±0.55	2.20±0.45	2.60±0.89	2.60±0.89
Peripheral vision	6.40±0.55	6.60±0.55	7.00±1.73	6.60±1.34
Glare and adaptation to darkness	7.60±1.52	7.80±1.30	8.80±1.64	8.40±1.67
External mobility	1.00±0.00	1.00±0.00	1.20±0.45	1.40±0.55
Moderate glaucoma				
Central view	2.60±0.55	2.60±0.55	2.75±0.50	3.25±0.50
Peripheral vision	8.60±4.22	8.60±3.78	10.00±1.82	10.00±1.82
Glare and adaptation to darkness	7.20±1.79	7.40±1.67	9.75±1.23	9.75±1.23
External mobility	1.40±0.89	1.40±0.89	1.50±0.58	1.50±0.58

* p-value <0.05 comparing before and after intragroup; † p-value <0.05 comparing final score (after) between groups; classification central vision <2 no difficulty, 2 to 6 mild difficulty, 6 to 8 moderate difficulty, >8 severe difficulty; peripheral vision rating <6 without difficulty, 6 to 17.9 mild difficulty, 18 to 24 moderate difficulty, >24 severe difficulty; glare and dark adaptation rating <6 no difficulty, 6 to 17.9 mild difficulty, 18 to 24 moderate difficulty, >24 severe difficulty; classification mobility abroad <1 without difficulty, 1 to 2.99 mild difficulty, 3 to 4 moderate difficulty, >4 severe difficulty.
SLT: selective laser trabeculoplasty; SD: standard deviation.

DISCUSSION

During the last 10 years in the different glaucoma consensuses, many authors have tried to ensure that the ideal treatment in this pathology involves not only adequate control of IOP but also prioritizes the quality of life of patients by minimizing the adverse effects they may have with most of the topical drugs currently in use. With the advent of SLT, in theory, the possibility of this happening was found, so much so that with the first report of the LiGTH study, carried out in the United Kingdom published in 2019,[12] this procedure could be catalogued as the first line of choice in the management of glaucoma as well as prostaglandin analogues, but some authors still consider that in different populations, especially in developing countries where health systems are not the most robust, this procedure does not show the same indicators in the reduction of IOP.

This study shows at one-year follow-up, in both intervention groups, a good reduction in IOP, with a reduction of 23.4% for the SLT group and 23.6% for the patients who used latanoprost. Katz et al., in their study in 2012, showed similar results with IOP reduction, results very similar to those found by reaching IOP goals defined in that study.[13] The study by Damji et al. showed a 20% decrease in IOP at 6 and 12 months after SLT,[14] a result very similar to the present study where the SLT group showed a reduction with respect to baseline IOP of 22.9% at 6 months and 23.4% at 12 months. In the analysis of the data in this study, it is interesting to note that the IOP decrease 30 days after the intervention was greater in the SLT group than in the group of latanoprost users, with a percentage of 21.6% vs 18.7% respectively. It is also evident that the hypotensive power of SLT presented a maximum peak of IOP reduction at 90 days. It should be noted that IOP remained stable with the same degree of reduction for both groups in subsequent controls above 23% up to one year of follow-up.

A study conducted by Gómez-Goyeneche et al., in Bogota, Colombia,[3] where SLT was performed at 180° inferior, reported a decrease in IOP up to 19% at one year of follow-up; unlike the present study where the procedure was performed at 360°, obtaining a higher percentage of IOP decrease (23.4%).

One hundred percent of the patients in both groups had a IOP target at 365 days control according to the severity of the diagnosis, even the two patients who required additional interventions. The LiGTH study by Gazzard et al. reported that 94.2% of patients in the SLT group and 93.2% in the prostaglandin analogues group had a target IOP at 72 follow-up months.[8] These results indicate that in developing countries such as Colombia, the effectiveness and efficacy of SLT are similar to the use of prostaglandin analogues as in other countries.

Gazzard et al. in the LiGTH study reported a slight increase in the GQL-15 quality of life scale score at three follow-up years in both groups.[12] This implies a mild increase in difficulty in performing activities of daily living. This study, which evaluated a population of the Colombian Caribbean coast, did not show statistically significant differences in terms of worsening quality of life at 1-year follow-up; however, some differences were observed with respect to the LiGTH study. In patients suspected of glaucoma belonging to the SLT group, they presented worse subjective symptoms of peripheral vision loss compared to the group treated with latanoprost; on the other hand, in patients with a diagnosis of mild glaucoma, a subjective improvement in peripheral vision and glare was evidenced in the group treated with latanoprost compared to the SLT group. Finally, in patients with moderate glaucoma, a subjective perception of decreased central vision was observed in the prostaglandin analogues group, which could infer that this group developed some alteration affecting central vision and not peripheral vision as in patients with glaucoma. In general, all groups maintained a mild difficulty for the four categories that this scale evaluates.

Since the two therapies showed similar efficacy and there were no significant changes in the quality of life of the patients evaluated subjectively, both can be recommended as initial therapy in patients with early glaucoma.

CONCLUSION

Selective laser trabeculoplasty with Nd-YAG laser is as effective as the use of prostaglandin analogues as initial treatment in the early stages of glaucoma. Regarding the quality-of-life scale, although there were no statistically significant differences in both groups, selective laser trabeculoplasty showed an increase difficulty perceived by the patient for activities involving peripheral vision, which is the most affected in glaucoma patients.

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