

Case series about the role of selective laser trabeculoplasty in the management of primary open-angle glaucoma (about 34 eyes)

Abstract :

Introduction: Selective laser trabeculoplasty (SLT) is a physical treatment used to treat open-angle glaucoma. The aim of our study is to evaluate the efficacy and safety of the SLT, and to look for predictive factors of its success.

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Laser (Capital)

Comment [U2]: This study aims to....

Material and methods: Prospective, monocentric study carried out over a period of 8 months. 34 eyes of 17 patients who benefited from a session of SLT. The intra ocular pressure (IOP) was measured just before the laser, on the 7th day, then at one month, at the 3rd and finally at the 6th month. Success was defined as a decrease in IOP at 6 months \geq 20% from baseline.

Comment [U3]: A prospective study was carried

Results: The mean pressure drop was 1.7mmHg, 3.15mmHg, 4.49mmHg and 5.97mmHg at day 7, month 1, month 3 and month 6 respectively. The success rate was 61.7%. Factors for a good response to SLT in our series included the absence of diabetes and high baseline IOP. Other factors such as age, sex, race, hypertension, myopia, central corneal thickness, and the number of hypotonisers used do not seem to be correlated with the success of SLT.

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Discussion: Our study is consistent with the results found in the literature. A high initial IOP is the most important predictor of a good response. The complication found in our patients was pressure elevation at the 7th day control.

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Comment [U13]: of follow up.

Conclusion: SLT is an effective and well-tolerated alternative for the management of the primary open angle glaucoma. It can be used as either a primary intervention, a replacement for medication, or an additional therapy with glaucoma medications. And it has a good prognosis after 1 week & 1, 3 and 6 months follow up.

Keywords: Case series, Primary open angle glaucoma, Selective laser trabeculoplasty, Efficacy, Safety, Success factors

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Introduction

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Glaucoma is a progressive optic neuropathy characterised by functional impairment of the visual field and structural damage to the optic fibres [1]. It is the second most common cause of

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blindness after cataracts [2]. Glaucoma can be treated by lowering intraocular pressure through medical, physical or surgical treatment. Selective laser trabeculoplasty is an increasingly popular physical treatment. The aim of our study was to assess the efficacy and safety of SLT and to identify factors predictive of success.

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Materials and methods

This was a prospective study carried out over an 8-month period from March 2022 to October 2022.

We included in our study patients older than 20 years, with suspected primary open-angle glaucoma (POAG) according to the following criteria: high baseline IOP, and/or open iridocorneal angle: Shaffer ≥ 3 , suggestive visual field alteration and/or suggestive involvement on papillary and ganglion cell OCT. Patients newly diagnosed with, or already being followed up for POAG on mono-, bi-, tri- or quadri-therapy. We have obtained the consent of all our patients.

We excluded patients with secondary glaucoma pseudoexfoliative (PEX), pigmentary, cortisone-induced, post-traumatic, post-surgical, etc.), patients with a narrow iridocorneal angle (Shaffer < 3), patients who had previously undergone physical treatment or filtering surgery, changes in hypotonic treatment during the study unless the treatment was reduced.

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Before the SLT was performed, we recorded the following for each patient: Epidemiological data such as age, sex, ethnicity, pathological history; Clinical data, i.e. visual acuity, IOP using the Goldmann tonometer, gonioscopy, central corneal thickness; Therapeutic data: treatments previously instituted and those in progress, tolerance to usual treatment; Changes in IOP during the study.

The laser used was an Nd-Yag Q-Switch, LIGHTLAS 2. Thirty minutes before the procedure, patients were instilled with Pilocarpine and Apraclonidine. The laser was performed by the same operator using a Latina glass under topical anaesthesia. Fifty non-adjointing impacts were performed in a single session between 3 and 9 o'clock. We began with an energy of 0.5 mJ and progressively increased it until achieving a minimum formation of cavitation bubbles upon impact. Both eyes were treated successively during the same session. In addition to the usual hypotonic eye drops, the patients received a non-steroidal anti-inflammatory eye drop of 3 drops per day for 07 days. They were reviewed after 7 days, then at one month, three months and finally at six months.

Comment [U22]: anaesthesia

The success criteria were either a reduction in IOP $\geq 20\%$ and/or ≥ 4 mmHg compared with the initial IOP (just before SLT) at the 6th month. The statistical study was carried out using SPSS version 23 software. Given the size of the sample, the non-parametric Wilcoxon and Mann Whitney tests, as well as the Chi-square test and Fisher's exact test were used to compare the different variables. A value of $p < 0.05$ was considered statistically significant. This case series has been reported in line with the PROCESS Guideline [3].

Results

34 eyes from 17 patients were included in our study, 13 men and 4 women, giving a sex ratio of 3 men to 1 woman. The mean age was 65.64 years, with extremes between 46 and 84 years. Two patients were melanodermic, a percentage of 11.8%. Among the patients' medical histories, 35.3% had hypertension, 29.4% diabetes, 29.4% moderate myopia, 29.4% a family history of first-degree glaucoma and 35.3% no pathological history. It should be noted that some patients had several associated diseases.

Mean visual acuity was 8.05/10. Patients with a visual acuity of less than 2/10 accounted for 5.88%, while those with a visual acuity of $>7/10$ accounted for 64.7%. Overall visual acuity remained stable; the only decreases in visual acuity recorded were linked to cataracts in 2 patients, which were unrelated to SLT. The central corneal thickness was $504.02 \pm \mu\text{m}$. 77% of patients had a central corneal thickness (CCT) less than $520 \mu\text{m}$. The average CCT in the Moroccan population is $528 \pm 30 \mu\text{m}$. On gonioscopy, the mean Shaffer classification was 3.7.

12% of patients had never received local hypotonic treatment, 12% on monotherapy, 41% on dual therapy, 23% on triple therapy and 12% on quadritherapy. Patients on monotherapy were on prostaglandins, those on dual therapy were on beta-blockers (BB) and prostaglandins or carbonic anhydrase inhibitors (ACI). Patients on triple therapy were on BB + ACI + prostaglandin and those on quadritherapy were on BB + ACI + prostaglandin + alpha agonist.

We defined the degree of tolerance as a function of the number of adverse events experienced by patients undergoing treatment. In fact, 40% of patients had dry eyes, 14% had itching, 20% had red eyes, 13% had irritation and 13% had none of these symptoms. As a result, 76% of patients were on adjuvant therapy.

In our study, the mean IOP of the 34 eyes treated just before SLT was 19.88 mmHg. Follow-up of our patients showed a progressive reduction in IOP (**Figure 1**), with the following results: On day 7 post-SLT: the mean reduction was 9.47% (i.e. 1.7 mmHg), At the 1st month: the average reduction was 16.93% (i.e. 3.15 mmHg), At the 3rd month: an average reduction of 23.57% (i.e. 4.49 mmHg), At the 6th month, an average reduction of 30.80% (i.e. 5.97 mmHg). The success rate was 61.7%.

In our study we looked for factors that might influence response to SLT. We found no correlation between age or gender and response to SLT. The Pearson correlation coefficient was low ($R = 0.14$) and not significant ($p = 0.43$). We have the impression that melanodermic patients respond better to SLT (35% versus 25% on average). However, this is not significant given the small number of melanodermic cases (12%). The SLT laser appears to be more effective in non-diabetic patients than in diabetic patients ($p = 0.02$). Our figures give the impression that non-hypertensive patients respond better to the SLT laser than hypertensive patients, although these results are not

statistically significant ($p=0.13$). We found no significant difference in response to SLT between myopic and non-myopic patients ($p=0.25$). There was a very weak negative correlation between the age of the glaucoma and the response to SLT, i.e. the older the glaucoma, the less responsive it was to the laser, although this was not statistically significant, Pearson's coefficient = -0.08 ($p=0.65$). There is a strong correlation between initial IOP and the extent of the pressure reduction obtained after SLT. The Pearson correlation coefficient in our study was $r=0.85$ ($p<0.001$). This means that the higher the initial IOP, the greater the drop expected after SLT (Figure 2). We did not find a statistically significant correlation between CCT and response to SLT in our study.

These figures could suggest that patients with a greater number of antiglaucomatous eye drops respond better to SLT, although this is not statistically significant, as the limited number of patients in our study does not allow this difference to be demonstrated significantly (table 1).

The SLT is not without complications, but these are not very frequent. Laser tolerance in our study was generally good, with the only complication being a moderate rise in IOP, which were recorded on day 7 in 5 patients (29.4%). The average rise was 2.7 mmHg. It subsequently subsided without any change in the hypotonic treatment. Other complications such as inflammatory reactions, hyphaema and macular oedema were not found during follow-up.

Discussion

Since the first publication on SLT in 1998 by Latina and al [4], several studies have increasingly demonstrated the efficacy of selective laser trabeculoplasty in the treatment of open-angle glaucoma. In some studies, the success rate of SLT was relatively favourable (59.7% to 89%) [5, 6, 7, 8]. However, other studies have reported disappointing results, with a failure rate of 68-74% [10, 11].

We noted an overall progressive reduction in IOP after SLT which was remarkable from day 7, with a success rate of 61.7% at 6 months. This success rate is comparable to that of certain studies, and is summarised in table 2.

Comment [U23]: Table 2.

Our study does not allow us to follow up our patients in the medium (6 to 12 months) and long term (beyond 12 months). A recent meta-analysis [9] identified 35 studies, including eight randomised controlled trials evaluating IOP reduction 12 months or more after SLT. These studies included patients with ocular hypertension, POAG and other types of secondary open-angle glaucoma. SLT resulted in IOP reductions ranging from 6.9% to 35.9% of IOP. The mean IOP reduction after SLT is reported to be 21.8% at 6 months [13, 14, 15, 16], 16.9-30% at 12 months [13, 18, 19], 7.7-27.8% at 2 years [13, 20], 24.5-25.1% at 3 years [13, 20], 23.1-29.3% at 4

years [13, 20], 22.6-32.1% at 5 years [13, 20], and 22.8% at 6 years [13]. Based on the commonly adopted success criteria of a 20% reduction in IOP from baseline, the effect of SLT diminishes over time [21]. Figure 3 summarises these results.

We studied the factors predictive of the efficacy of SLT in order to determine the optimal indication for treatment. We found no significant relationship between SLT response and age or gender. Our results are in line with some studies in which age and sex do not appear to be predictive factors of SLT success [22, 23, 24]. However, Martow et al. found that the association between female gender and a good response to LTS was statistically significant ($p=0.02$) [9]. We found that non-diabetic subjects responded better to the SLT laser than diabetic subjects ($P=0.02$). This could be explained by the fact that diabetes alters tissue structure and therefore results in an insufficient response to the SLT laser. On the other hand, Jacky Lee et al. and other authors have shown in their studies that diabetes does not play a role in the success of the SLT laser [9, 23]. Melanoderms subjects seemed to respond better to SLT, with a mean reduction in IOP of 35% compared with 25% in favour of melanoderms subjects. These results may be compared with the study by S.M. in Dakar, involving 69 eyes of melanoderma patients, which showed that SLT was effective in around 90% of eyes, and led to prostaglandins being stopped in 60% of patients [25]. In black subjects, glaucoma often occurs earlier, progresses rapidly and is difficult to treat. We found that there was no statistically significant association between hypertension and a fall in IOP after SLT ($p=0.13$), as has been reported in the literature [23]. Our results do not allow us to demonstrate a relationship between response to SLT and the presence of myopia. As Tardif shows in his study, the presence of myopia does not seem to be a predictive factor for the success of a first SLT treatment [26]. There is a very weak negative correlation between the age of the glaucoma and the response to SLT.

In our series, the greatest pressure reduction was obtained among patients with high baseline IOP with Pearson's correlation coefficient in our study being $r=0.85$ ($p<0.001$). A recent study by Chang et al [27] reported that a higher baseline IOP was associated with a reduced risk of non-response (OR = 0.60, $P < 0.0001$ for an increase of 3 mm Hg). In the literature, the most important predictive factor found was a high baseline IOP [24, 26, 27]. This will allow us to propose SLT to patients with isolated ocular hypertension (open angle) or associated with open angle glaucoma. The mean of the central corneal thickness (CCT) found in our study is thin ($504\mu\text{m}$) and its correlation with the success of SLT is not statistically significant, as some authors have shown [9, 10]. According to Shazly et al, the percentage reduction in IOP after SLT was significantly higher in eyes with an $\text{CCT} < 555\mu\text{m}$ for at least 30 months in patients with POAG and OHT ($p < 0.05$) [29].

The correlation between the fall in IOP and the number of hypotonisers was not significant ($p=0.07$). These results can be compared with the study by Woo et al [15] who did not find a

significant difference in the success rate according to the number of concomitant topical medications. In contrast, Lee et al [23] showed that the use of several topical medications, particularly carbonic anhydrase inhibitors, was associated with successful treatment with SLT. Bruen et al [22] found that pretreatment with prostaglandins was associated with a reduced IOP response. This is possible because SLT and prostaglandins are thought to share an almost common biological mechanism of action [30].

Hypotonating eye drops are a source of numerous side effects, with an increased frequency of dry eye, which was found in 40% of our patients. Local treatment must therefore generally be accompanied by adjuvant treatments, which increase the cost of patient care. According to our study, 52.94% of our patients were on artificial tears, and 11.8% were also on anti-allergy treatments. We were able to withdraw eye drops for 3 patients. The average number of hypotonisers per patient was 2.12 before the Laser SLT, falling to 2.05 at the 6th month. Similarly, in patients who underwent SLT as a first-line treatment, we obtained a reduction in IOP that did not require the addition of local treatment. The LiGHT study [31] demonstrated that SLT on naïve eyes is effective for the treatment of POAG and OHT in first-line treatment, it offers superior pressure stability compared with drops, at lower cost and, above all, it enables control to be achieved in 74% of patients without drops for at least 3 years after SLT. In the United States, Cantor et al [32] compared the costs of medically uncontrolled glaucoma treated with other medications versus SLT or surgery if necessary. They found that the cumulative costs over 5 years per patient were \$6571, \$4838 and \$6363 in the drug, SLT and surgery groups respectively. In our study we tried to compare the economic benefit for the same patient of undergoing SLT or being put on Latanoprost for 6 months to reduce IOP, the costs being 1000 MAD and 1062 MAD respectively. In the short term, the difference is not palpable, but in the medium and long term it could be, especially if the patient has responded well to SLT. The use of laser treatment as a first-line intervention avoids the problems of side-effects, compliance and drug-related costs, and the risks associated with glaucoma surgery. The efficacy of SLT as a first-line treatment for open-angle glaucoma is comparable to that of Latanoprost eye drops over a 12-month period, according to Ian McIlraith's study [17].

Complications associated with SLT are generally transient. In our study, the only complication found was a transient rise in IOP on day 7 in 29% of our patients; no other complications were found. IOP peaks can occur immediately after SLT. Increases of ≥ 5 mm Hg have been reported in up to 28% of eyes [33]. An association between IOP spikes has been observed in patients with a heavily pigmented trabeculum [34]. Anterior chamber inflammation is also common after SLT, with up to 83% of eyes showing some degree of inflammation [35].

The limitations of our study are, firstly, its relatively short duration, which does not allow us to assess the efficacy of the treatment in the medium and long term, but also the size of the sample studied and the monocentric nature of the study.

CONCLUSION

We have found our results to be consistent with most of the literature. The decrease in intraocular pressure is obtained progressively from the 7th day and continues until the 6th month. We can say that SLT is an effective and promising alternative for the treatment of POAG. The only factor that remains commonly correlated with a better success rate of SLT is the extent of the initial IOP elevation. Medium- and long-term studies show a decline in its effectiveness over time, but SLT offers the possibility of retreatment of the surface of the angle that has not been or has already been treated.

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FIGURES

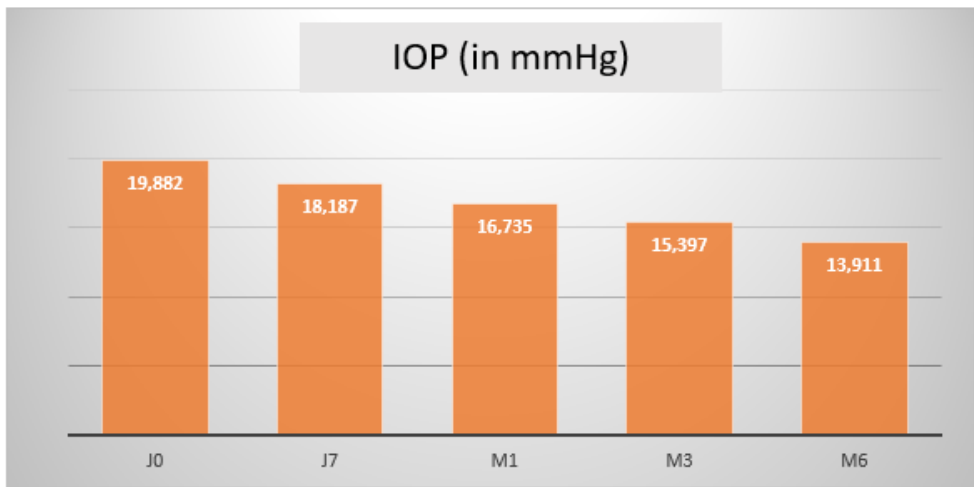


Figure 1 : Evolutionary profile of IOP in patients treated with SLT.

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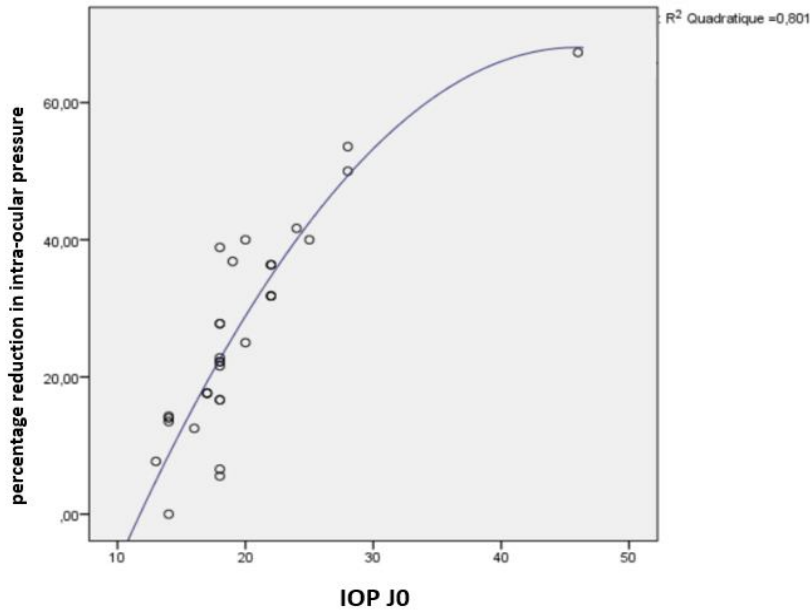


Figure 2: correlation between pressure reduction at the 6th month after SLT and initial IOP



Figure 3: Success rate of SLT over time (percentage) according to medium- and long-term studies

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TABLES

	Group B (n= 18)	Group C (n=12)	<i>p</i>
Reduction in IOP at 6th month (in percent)	22 ± 11,7	31,5 ± 14,3	0,07

Table 1: Comparison of pressure reduction at month 6 according to the groups defined by the number of antiglaucoma eye drops. Group B (patients on mono or bitherapy); Group C (patients on tri or quadritherapy).

Comment [U27]: Group B (patients withoutspace)

Authors	Population	Protocol SLT	Initial IOP	Follow-up period	IOP reduction	Successcriteria	Success rate
Latina and al 1998 [4]	53 eyesPOAG	SLT on 180° Nasal	24.6	6,5months	4.6 (18%)	Average IOP reduction \geq 3mm Hg	70%
Chen and al 2004 [36]	32 patients POAG/PExG	SLT on 180°	26,1	7 months	6,16	IOP control with no therapeutic modification	NP
Juzychand al 2004 [37]	41 eyesPOAG	SLT on 180° nasal	23,9 \pm 2,6	37,4 \pm 14,7 months	NC	Average IOP reduction \geq 3mm Hg or > 20%	1year : 68% 3years :46% 5years :32%
Hodget and al 2005 [38]	72 eyesPOAG	SLT on 180° inf.	23.8 \pm 4,9	1 year	5,8	Average IOP reduction \geq 20%	59,7%
Damjiand al 2006 [8]	78 eyesPOAG	SLT on 180°	23,8	12 months	6,1 \pm 5,9 (23%)	Average IOP reduction \geq 20%	55,12%
McIlraithand al 2006 [17]	74 eyesPOAG	SLT on 180° inf	26	12 months	8,3 (31%)	Average IOP reduction \geq 30%	55%
Zaninettiand al 2008 [39]	44 eyesPOAG /PExG / OHT	SLT on 180° inf	19,2 \pm 4,7	2 years (36 eyes)	3,3 (17%)	Average IOP reduction \geq 20%	6months :51% 2ans : 48%
Hong and al 2009 [40]	44 eyesPOAG /PExG	SLT on 360°	20,1 (SLT1) 19,5 (SLT2)	8 months	4 2,9	Average IOP reduction \geq 20%	50%
Lee and al 2015 [41]	83 eyesNPG	SLT on 180°	16.1 \pm 2.2	6 months	4,7 \pm 1,8 (29,7%)	Average IOP reduction \geq 30%	56,6%
Our study	34 eyes POAG	SLT on 180°inf.	19,88	6 months	30,8%	Average IOP reduction>20%	61,7%

Table 2 : Comparison of our result with those in the literature

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Comment [U28]: Actualicesomereferencefrom 2020 to 2024

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