Case seriesabout the role of selective laser trabeculoplasty in the management of primary open-angle glaucoma (about34 eyes)

Abstract :

Introduction:Selective laser trabeculoplasty (SLT) is a physicaltreatmentused to treat open-angle glaucoma. The aim of ourstudyis to evaluate the efficacy and safety of the SLT, and to look for predictivefactors of itssuccess.

Material and methods: Prospective, monocentricstudycarried out over a period of 8 months. 34 eyes of 17 patients whobenefitedfrom a session of SLT. The intra ocular pression (IOP)wasmeasuredjustbefore the laser, on the 7th day, then at one month, at the 3rd and finally at the 6th month. Successwasdefined as a decrease in IOP at 6 months ≥ 20% frombaseline.

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 ourseriesincluded the absence of diabetes and high baseline IOP. Otherfactorssuch as age, sex, race, hypertension, myopia, central cornealthickness, and the number of hypotonisersused do not seem to becorrelatedwith the success of SLT.

Discussion: Our studyis consistent with the resultsfound 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.

Conclusion: SLT is an effective and welltolerated alternative for the management of the primary open angle glaucoma. It can beused as either a primary intervention, a replacement for medication, or an additionaltherapywithglaucomamedications. And it has a goodprognosisafter 1 week& 1,3 and 6 months follow up.

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

Introduction

Glaucomais a progressive opticneuropathycharacterised by functionalimpairment of the visualfield and structural damage to the optic fibres[1]. It is the second mostcommon cause of

blindnessaftercataracts[2]. Glaucoma can betreated byloweringintraocular pressure throughmedical, physical or surgicaltreatment. Selective laser trabeculoplastyisan increasinglypopularphysicaltreatment. The aim of ourstudywas to assess the efficacy and safety of SLT and to identifyfactorspredictive of success.

Materials and methods

This was a prospective studycarried out over an 8-month periodfrom March 2022 to October 2022.

Weincluded in ourstudy patients olderthan 20 years, withsuspectedprimary open-angle glaucoma (POAG)according to the followingcriteria: high baseline IOP, and/or open iridocorneal angle: Shaffer ≥ 3, suggestive visualfieldalteration and/or suggestive involvement on papillary and ganglion cell OCT. Patients newlydiagnosedwith, or alreadybeingfollowed up for POAG on mono-, bi-, tri- or quadri-therapy.We have obtained the consent of all our patients.

Weexcluded patients withsecondaryglaucomapseudoexfoliative (PEx), pigmentary, cortisone-induced, post-traumatic, post-surgical, etc.), patients with a narrowiridocorneal angle (Shaffer< 3), patients whohadpreviouslyundergonephysicaltreatment or filteringsurgery, changes in hypotonisingtreatmentduring the studyunless the treatmentwasreduced.

Before the SLT wasperformed, werecorded the following for eachpatient:Epidemiological data such as age, sex, ethnicity, pathologicalhistory; Clinical data, i.e. visualacuity, IOPusing the Goldmann tonometer, gonioscopy, central cornealthickness; Therapeutic data: treatmentspreviouslyinstituted and those in progress, tolerance to usualtreatment; Changes in IOP during the study.

The laser usedwas an Nd-Yag Q-Switch, LIGHTLas 2. Thirty minutes before the procedure, patients wereinstilledwith Pilocarpine and Apraclonidine. The laser wasperformed by the sameoperatorusing a Latina glass undertopicalanaesthesia. Fifty non-adjoining impacts wereperformed in a single session between 3 and 9 o'clock. Webeganwith an energy of 0.5 mJ and progressivelyincreasedituntilachieving a minimum formation of cavitation bubblesupon impact. Botheyesweretreatedsuccessivelyduring the same session. In addition to the usualhypotonisingeye drops, the patients received a non-steroidal anti-inflammatoryeye drop of 3 drops per day for 07 days. Theywerereviewedafter 7 days, then at one month, threemonths and finally at six months.

The successcriteriawereeither a reduction in IOP ≥ 20% and/or ≥ 4mmHg comparedwith the initial IOP (justbefore SLT) at the 6th month. The statisticalstudywascarried 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 wereused to compare the different variables. A value of $p<0.05$ wasconsideredstatisticallysignificant.This case series has been reported in line with the PROCESS Guideline [3].

Results

34 eyesfrom 17 patients wereincluded in ourstudy, 13 men and 4 women, giving a sex ratio of 3 men to 1 woman. The meanagewas 65.64 years, withextremesbetween 46 and 84 years. Two patients weremelanodermic, a percentage of 11.8%. Among the patients' medical histories, 35.3% had hypertension, 29.4% diabetes, 29.4% moderatemyopia, 29.4% a familyhistory of first-degreeglaucoma and 35.3% no pathologicalhistory. It shouldbenotedthatsome patients hadseveralassociateddisease.

Meanvisualacuitywas 8.05/10. Patients with a visualacuity of lessthan 2/10 accounted for 5.88%, whilethosewith a visualacuity of >7/10 accounted for 64.7%. Overallvisualacuityremainedstable; the onlydecreases in visualacuityrecordedwerelinked to cataractsin 2 patients, whichwereunrelated to SLT. The central cornealthicknesswas 504.02± µm. 77% of patients had a central cornealthickness(CCT) lessthan 520µm. The average CCT in the Moroccan population is 528 +/- 30 µm. On gonioscopy, the meanShaffer classification was 3.7.

12% of patients hadneverreceived local hypotonisingtreatment, 12% on monotherapy, 41% on dual therapy, 23% on triple therapy and 12% on quadritherapy. Patients on monotherapywere on prostaglandins, those on dual therapywere on beta-blockers (BB) and prostaglandins or carbonic anhydrase inhibitors (ACI). Patients on triple therapywere on BB + ACI + prostaglandin and those on quadritherapywere on BB + ACI + prostaglandin + alpha agonist.

Wedefined the degree of tolerance as a function of the number of adverse eventsexperienced by patients undergoingtreatment. In fact, 40% of patients had dry eyes, 14% haditching, 20% hadredeyes, 13% had irritation and 13% had none of thesesymptoms. As a result, 76% of patients wereon adjuvant therapy.

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

In ourstudywelooked for factorsthatmight influence response to SLT. Wefound no correlationbetweenage or gender and response to SLT. The Pearson correlation coefficient waslow (R= 0.14) and not significant (p=0.43). We have the impression thatmelanodermic patientsrespondbetter to SLT (35% versus 25% on average). However, thisis not significantgiven the smallnumber of melanoderm cases (12%). The SLT laser appears to be more effective in non-diabetic patients than in diabetic patients (p=0.02). Our figuresgive the impression that non-hypertensive patients respondbetter to the SLT laser than hypertensive patients, althoughtheseresults are not

statisticallysignificant (p=0.13). Wefound no significantdifference in response to SLT betweenmyopic and non-myopic patients (p=0.25). There was a veryweaknegativecorrelationbetween the age of the glaucoma and the response to SLT, i.e. the older the glaucoma, the less responsive itwas to the laser, althoughthiswas not statisticallysignificant, Pearson's coefficient = -0.08 (p= 0.65). There is a strongcorrelationbetween initial IOP and the extent of the pressure reductionobtainedafter SLT. The Pearson correlation coefficient in ourstudywas r =0.85 (p<0.001). This meansthat the higher the initial IOP, the greater the drop expectedafter SLT **(Figure 2)**. Wedid not find a statisticallysignificantcorrelationbetweenCCT and response to SLT in ourstudy.

These figures couldsuggestthat patients with a greaternumber of antiglaucomatouseye drops respondbetter to SLT, althoughthisis not statisticallysignificant, as the limitednumber of patients in ourstudydoes not allowthisdifference to bedemonstratedsignificantly**(table 1)**.

The SLTis not without complications, but these are not veryfrequent. Laser tolerance in ourstudywasgenerally good, with the only complication being a moderaterise in IOP, whichwerecorded on day 7 in 5 patients (29.4%). The averagerisewas 2.7 mmHg. It subsequentlysubsidedwithoutany change in the hypotonisingtreatment. Other complications such as inflammatoryreactions, hyphaema and macularoedemawere not foundduring follow-up.

Discussion

Since the first publication on SLT in 1998 by Latina and al **[4]**, severalstudies have increasinglydemonstrated the efficacy of selective laser trabeculoplasty in the treatment of open-angle glaucoma. In somestudies, the success rate of SLT wasrelativelyfavourable (59.7% to 89%) **[5, 6 ,7 ,8]**. However, otherstudies have reporteddisappointingresults, with a failure rate of 68-74% **[10, 11]**.

Wenoted an overall progressive reduction in IOP after SLT whichwasremarkablefromday 7, with a success rate of 61.7% at 6 months. This success rate is comparable to that of certain studies, and issummarised in **table 2**.

Our studydoes not allow us to follow up our patients in the medium (6 to 12 months) and long term (beyond 12 months). A recentmeta-analysis [9] identified 35 studies, includingeightrandomisedcontrolled trials evaluating IOP reduction 12 months or more after SLT. Thesestudiesincluded patients withocularhypertonia, POAG and other types of secondary open-angle glaucoma. SLT resulted in IOP reductionsrangingfrom 6.9% to 35.9% of IOP. The mean IOP reductionafter SLT isreported 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 commonlyadoptedsuccesscriteria of a 20% reduction in IOP frombaseline, the effect of SLT diminishes over time [21]. Figure 3summarisestheseresults.

Westudied the factorspredictive of the efficacy of SLT in order to determine the optimal indication for treatment. Wefound no significantrelationshipbetween SLT response and age or gender. Our results are in line withsomestudies in whichage and sex do not appear to bepredictivefactors of SLT success[22,23,24]. However, Martow et al. foundthat the association betweenfemalegender and a good response to LTS wasstatisticallysignificant (p=0.02) [9]. Wefoundthat non-diabeticsubjectsrespondedbetter to the SLT laser thandiabeticsubjects (P=0.02). This couldbeexplained by the factthatdiabetesalters tissue structure and thereforeresults in an insufficientresponse to the SLT laser. On the other hand, Jacky Lee et al. andotherauthors have shown in theirstudiesthatdiabetesdoes not play a role in the success of the SLT laser [9, 23]. Melanodermsubjectsseemed to respondbetter to SLT, with a meanreduction in IOP of 35% comparedwith 25% in favour of melanodermsubjects. Theseresultsmaybecomparedwith the study by S.M. in Dakar, involving 69 eyes of melanoderma patients, whichshowedthat SLT was effective in around 90% of eyes, and led to prostaglandinsbeingstoppedin 60% of patients [25]. In black subjects, glaucomaoftenoccursearlier, progresses rapidly and isdifficult to treat. Wefoundthattherewas no statisticallysignificant 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 relationshipbetweenresponse to SLT and the presence of myopia. As Tardif shows in hisstudy, the presence of myopiadoes not seem to be a predictive factor for the success of a first SLT treatment[26]. There is a veryweaknegativecorrelationbetween the age of the glaucoma and the response to SLT.

In ourseries, the greatest pressure reductionwasobtainedamong patients with high baseline IOP withPearson'scorrelation coefficient in ourstudybeing r =0.85 (p<0.001). A recentstudy by Chang et al [27]reportedthat a higherbaseline IOP wasassociatedwith a reducedrisk of non-response (OR = 0.60, P < 0.0001 for an increase of 3 mm Hg). In the literature, the most important predictive factor foundwas a high baseline IOP [24 ,26,27]. This willallow us to propose SLT to patients withisolatedocularhypertonia (open angle) or associatedwith open angle glaucoma. The meanof the central cornealthickness (CCT)found in ourstudyisthin (504µm) and itscorrelationwith the success of SLT is not statisticallysignificant, as someauthors have shown[9,10]. According to Shazly et al, the percentage reduction in IOP after SLT wassignificantlyhigher in eyeswith an CCT<555mm for at least 30 months in patients withPOAG and OHT (p<0.05) [29].

The correlationbetween the fall in IOP and the number of hypotoniserswas not significant (p=0.07). Theseresults can becomparedwith the study by Woo et al [15]whodid not find a

significantdifference in the success rate according to the number of concomitant topicalmedications. In contrast, Lee et al [23]showedthat the use of severaltopicalmedications, particularlycarbonic anhydrase inhibitors, wasassociatedwithsuccessfultreatmentwith SLT. Bruen et al [22]foundthatpretreatmentwithprostaglandinswasassociatedwith a reduced IOP response. This is possible because SLT and prostaglandins are thought to share an almostcommonbiologicalmechanism of action [30].

Hypotonatingeye drops are a source of numeroussideeffects ,with an increasedfrequency of dry eye, whichwasfoundin 40% of our patients. Local treatment must thereforegenerallybeaccompanied by adjuvant treatments, whichincrease the cost of patient care. According to ourstudy, 52.94% of our patients were on artificialtears, and 11.8% werealso on anti-allergytreatments. Wewere able to withdraweye drops for 3 patients. The averagenumber of hypotonisers per patient was 2.12 before the Laser SLT, falling to 2.05 at the 6th month. Similarly, in patients whounderwent SLT as a first-line treatment, weobtained a reduction in IOP thatdid not require the addition of local treatment. The LiGHTstudy[31]demonstratedthat SLT on naïve eyesis effective for the treatment of POAG and OHT in first-line treatment, itofferssuperior pressure stabilitycomparedwith drops, at lowercost and, above all, it enables control to beachievedin 74% of patients without drops for at least 3 yearsafter SLT. In the United States, Cantor et al [32]compared the costs of medicallyuncontrolledglaucomatreatedwithothermedications versus SLT or surgery if necessary. Theyfoundthat the cumulative costs over 5 years per patient were $6571, $4838 and $6363 in the drug, SLT and surgery groups respectively. In ourstudywetried to compare the economicbenefit for the same patient of undergoingSLT or being put on Latanoprost for 6 months to reduce IOP, the costsbeing 1000 MAD and 1062 MAD respectively. In the short term, the differenceis not palpable, but in the medium and long termitcouldbe, especially if the patient has respondedwell to SLT. The use of laser treatment as a first-line intervention avoids the problems of side-effects, compliance and drug-relatedcosts, and the risksassociatedwithglaucomasurgery. The efficacy of SLT as a first-line treatment for open-angle glaucomais comparable to that of Latanoprosteye drops over a 12-month period, according to Ian McIlraith'sstudy[17].

Complications associatedwith SLT are generally transient. In ourstudy, the only complication foundwas a transient rise in IOP on day 7 in 29% of ourpatients; no other complications werefound. IOP peaks can occurimmediatelyafter 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 heavilypigmentedtrabeculum[34]. Anteriorchamber inflammation isalsocommonafter SLT, with up to 83% of eyesshowingsomedegree of inflammation [35].

The limitations of ourstudy are, firstly, itsrelatively short duration, whichdoes not allow us to assess the efficacy of the treatment in the medium and long term, but also the size of the samplestudied and the monocentric nature of the study.

CONCLUSION

We have foundourresults to be consistent withmost of the literature. The decrease in intraocular pressure isobtainedprogressivelyfrom the 7th day and continues until the 6th month. We can saythat SLT is an effective and promising alternative for the treatment of POAG. The only factor thatremainscommonlycorrelatedwith a bettersuccess rate of SLT is the extent of the initial IOP elevation. Medium- and long-termstudies show a decline in itseffectiveness over time, but SLT offers the possibility of retreatment of the surface of the angle that has not been or has already been treated.

FIGURES

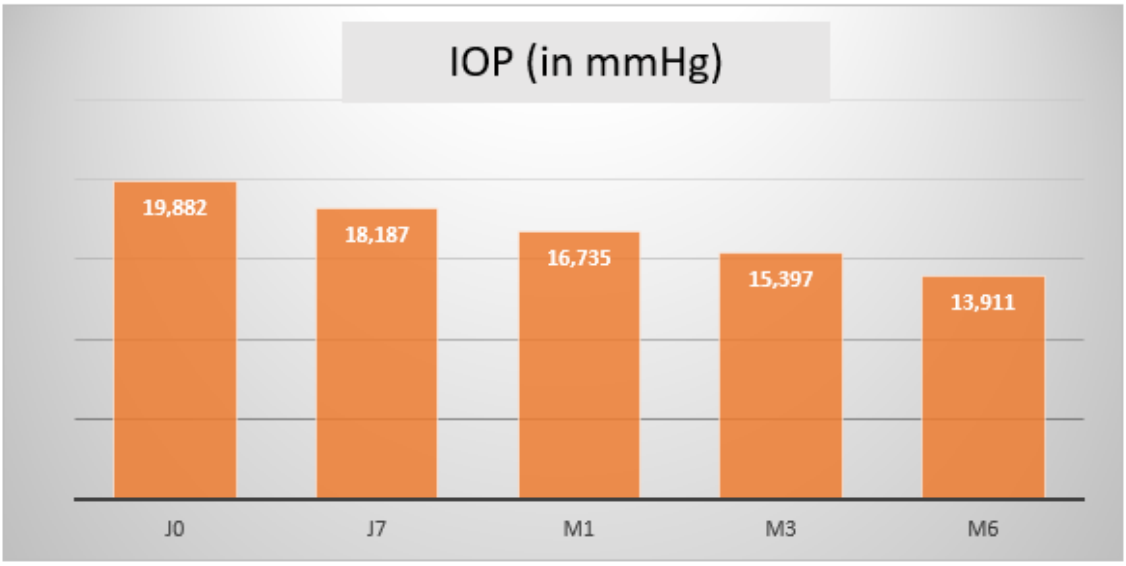

Figure 1 : Evolutionary profile of IOP in patients treatedwith SLT.

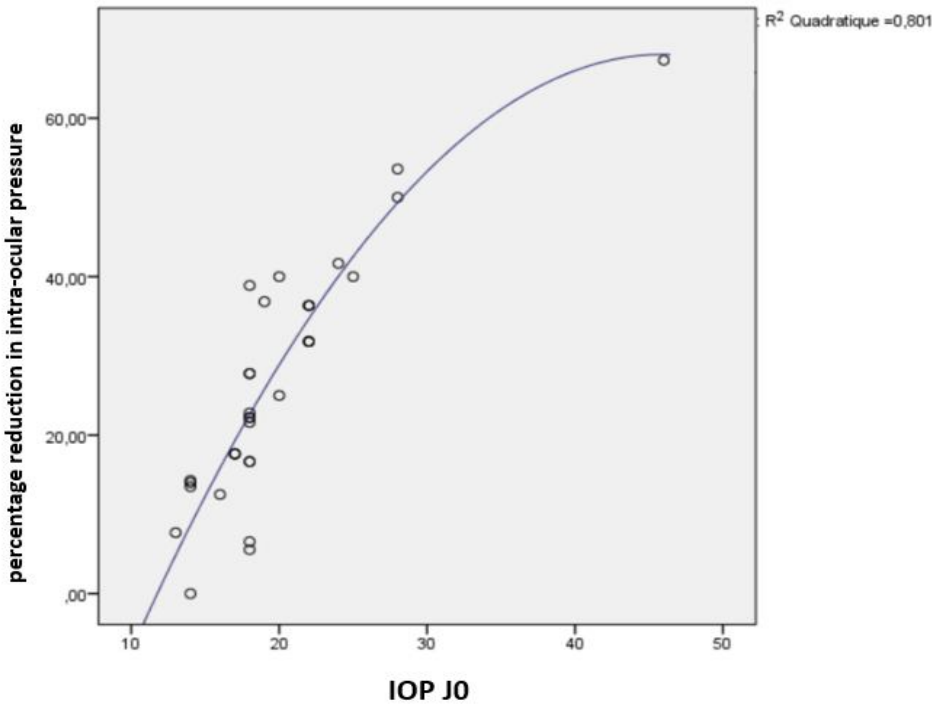

Figure 2: correlation between pressure reduction at the 6th month after SLT and initial IOP

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

TABLES

	Group B (n= 18)	Group C (n=12)	*p*
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 antiglaucomaeye drops.GroupB(patients on mono or bitherapy) ; Group C (patients on tri or quadritherapy).

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≥ 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 ±2,6	37,4±14,7 months	NC	Average IOP reduction≥ 3mm Hg or > 20%	1year : 68% 3years :46% 5years :32%
Hodget and al 2005 [38]	72 eyesPOAG	SLT on 180° inf.	23.8±4,9	1 year	5,8	Average IOP reduction≥ 20%	59,7%
Damjiand al 2006 [8]	78 eyesPOAG	SLT on 180°	23,8	12 months	6,1 ±5,9 (23%)	Average IOP reduction≥ 20%	55,12%
McIlraithand al 2006 [17]	74 eyesPOAG	SLT on 180° inf	26	12 months	8,3 (31%)	Average IOP reduction≥ 30%	55%
Zaninettiand al 2008 [39]	44 eyesPOAG /PExG / OHT	SLT on 180° inf	19,2 ±4,7	2 years (36 eyes)	3,3 (17%)	Average IOP reduction≥ 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≥ 20%	50%
Lee and al 2015 [41]	83 eyesNPG	SLT on 180°	16.1 ± 2.2	6 months	4,7±1,8 (29,7%)	Average IOP reduction≥ 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 ourresultswiththose in the literature

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