

EFFICIENCY OF ARGON LASER TRABECULOPLASTY IN OPEN ANGLE GLAUCOMA THERAPY

Suncica Sreckovic, Nenad Petrovic
Clinic of Eye Diseases, Clinical Centre Kragujevac, Kragujevac, Serbia

EFIKASNOST ARGON LASER TRABEKULOPLASTIKE U TERAPIJI GLAUKOMA OTVORENOG UGLA

Sunčica Srećković, Nenad Petrović
Klinika za očne bolesti, Klinički centar Kragujevac, Kragujevac, Srbija

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ABSTRACT

Introduction. Argon laser trabeculoplasty (ALT) is a method for the reduction of intraocular pressure (IOP) that involves applying a laser to the area of the trabecular meshwork of the chamber angle in patients with open angle glaucoma.

Aims. To evaluate the efficiency and safety of ALT in open angle glaucoma therapy.

Material and method. A prospective examination of 84 eyes from 49 patients who were primarily treated with medications but did not achieve sufficient control of their IOP. Prior to ALT, a detailed ophthalmology check had been performed. After the treatment, follow-up visits were scheduled at 24 hours, 1 month, 3 months, 6 months, 1 year, 2 years and 4 years. The success of the treatment was defined by $IOP \leq 21$ mmHg, with no further progression of disc or visual field changes.

Results. The average value of IOP before ALT was 25.28 ± 1.56 mmHg. After 24 hours, 19 eyes (23.5%) had a transitory rise in the IOP of < 4 mmHg. One month after the treatment the average IOP was 19.68 ± 2.26 mmHg, and 3 months later it was 18.01 ± 1.87 mmHg. At 6 months it was 17.4 ± 1.65 mmHg, at 1 year 17.96 ± 2.44 mmHg, at 2 years 18.22 ± 2.65 mmHg and at 4 years 18.49 ± 2.95 mmHg. The target pressure of ≤ 21 mmHg was achieved after 1 month in 77.8% of the patients, after 3 months in 93.8%, after 6 months in 93.8%, after 1 year in 80.2%, after 2 years in 75.3% and after 4 years in 66.7%. Two years after the treatment, a filtering surgery was performed in one case (1.2%), due to an unreduced IOP. At the end of the fourth year after the intervention, the number of examined eyes was 73, and a filtering surgery was performed for the unreduced IOP on 8 eyes (9.9%). The average reduction in IOP one year after the intervention was 7.32 ± 2.84 mmHg, after 2 years 7.16 ± 2.98 mmHg, and after 4 years 6.84 ± 3.33 mmHg ($p < 0.01$).

Conclusion. ALT is a safe and efficient method for IOP reduction in patients with open angle glaucoma, which can postpone filtering surgery to a great extent.

Key words. Open angle glaucoma, argon laser trabeculoplasty, intraocular pressure.

SAŽETAK

Uvod. Argon laser trabekuloplastika (ALT) je metoda sniženja intraokularnog pritiska (IOP) aplikacijom laserskih pečata u području trabekularne mreže komornog ugla kod pacijenata obolelih od glaukoma otvorenog ugla.

Cilj. Evaluacija efikasnosti i bezbednosti ALT u terapiji glaukoma otvorenog ugla.

Materijal i metod. Prospektivnim ispitivanjem je obuhvaćeno 84 oka, 49 pacijenta prethodno tretiranih medikamentnom terapijom kojom nije postignuta zadovoljavajuća kontrola IOP. Pre izvođenja ALT urađen je detaljan oftalmološki pregled. Nakon izvođenja intervencije kontrolni pegledi su obavljani nakon 24h, mesec dana, 3 meseca, 6 meseci, nakon 1 godine, 2 godine i 4 godine. Uspeh tretmana smo definisali kao $IOP \leq 21$ mmHg bez dalje progresije ekskavacije papile vidnog živca i progresije ispada u vidnom polju.

Rezultati. Prosečna vrednost IOP pre izvođenja ALT je bila $25,28 \pm 1,56$ mmHg. 24h od intervencije kod 19 očiju (23,5%) zabeležen je tranzitorni skok IOP koji je iznosio < 4 mmHg. Nakon mesec dana od intervencije prosečna vrednost IOP je iznosila $19,68 \pm 2,26$ mmHg, 3 meseca $18,01 \pm 1,87$ mmHg, 6 meseci $17,4 \pm 1,65$ mmHg, 1 godine $17,96 \pm 2,44$ mmHg, 2 godine $18,22 \pm 2,65$ mmHg i 4 godine $18,49 \pm 2,95$ mmHg. Ciljni pritisak ≤ 21 mmHg je postignut nakon 1 meseca kod 77,8%, 3 meseca 93,8%, 6 meseci 93,8%, 1 godine 80,2%, 2 godine 75,3% i 4 godine 66,7%. Dve godine od tretmana u jednom slučaju je zbog neregulisanog IOP urađena filtraciona operacija (1,2%). Na kraju četvrte godine od intervencije broj posmatranih očiju je iznosio 73, jer je zbog neregulisanog IOP kod 8 očiju izvedena filtraciona operacija (9,9%). Prosečno postignuto sniženje IOP godinu dana od intervencije iznosi $7,32 \pm 2,84$ mmHg, dve godine od intervencije $7,16 \pm 2,98$ mmHg, a četiri godine od intervencije $6,84 \pm 3,33$ mmHg ($p < 0,01$).

Zaključak. ALT je bezbedna i efikasna metoda sniženja IOP kod pacijenata sa glaukomom otvorenog ugla koja u visokom procentu može odložiti filtracionu operaciju.

Ključne reči. Glaukom otvorenog ugla, argon laser trabekuloplastika, intraokularni pritisak

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Correspondence: Assist. Sunčica Srećković, Clinic of Eye Diseases, Clinical Centre Kragujevac; Zmaj Jovina 30, 34000 Kragujevac; Tel +381 34 505085; e-mail sunshineg@sbb.co.yu



INTRODUCTION

Glaucoma is a chronic optic neuropathy that manifests with an increased intraocular pressure (IOP), cup disc ratio and paracentral scotomas in the visual field. It is progressive and often followed by an unfavourable clinical course. According to all relevant statistics, it is one of the three most frequent causes of blindness worldwide and in Serbia (10-15%). The prevalence of glaucoma is 1-2% in persons older than 40 years of age, and it progressively increases with age. Therefore, the prevalence is 3% for persons between 70 and 80 years of age.

According to the 2005 data from the Blind Persons' Society register for Serbia and Montenegro, out of 12,000 blind persons who were registered, 1,500 had been suffering from glaucoma (1). Primary prevention is not available, but due to a timely diagnosis and adequate therapy, it has been possible to slow down the clinical course of the illness and significantly lower the percentage of cases that end in blindness.

Open angle glaucoma is a multi-factorial illness, which is initiated by a number of risk factors, such as higher IOP, age, inheritance, sex, race, diabetes, hypertension, vasospasm and myopia (2,3,4,5). IOP is the most significant risk factor, and the illness itself is of a progressive nature with irreversible consequences, so the treatment has been mostly focused on IOP reduction. Prevention of the loss of visual functions by glaucoma begins with a therapy that involves efficient and energetic medications. In this case, a great deal of attention must be paid in order to determine that the therapy is safe and does not cause more damage than the illness itself. In those cases in which a satisfactory IOP has not been achieved, ALT can be conducted in order to achieve an additional reduction of IOP prior to deciding to perform a filtering surgery. In addition to this secondary role, ALT is also efficient as a primary therapy of open angle glaucoma.

ALT reduces IOP by applying a laser to the area of the trabecular meshwork of the chamber angle in patients with open angle glaucoma. The introduction of this method in practice to treat open angle glaucoma was first done by Krasnov, who in 1973 (6) performed a lasertrabeculopunctura of Schlemm's canal using a laser, but this reduction in the IOP only lasted for a short period. In 1979, Wise and Weiter achieved a consistent reduction of IOP by applying spots from an impenetrable argon laser (7). This intervention was successful in most cases, but the results have decreased over the course of time. After one year, the IOP was controlled in 67-80% cases, 5 years after the intervention in 35-50%, and 10 years after the intervention in 5-30% (8,9).

The complications from ALT are small and temporary. Early complications include transitory sight that is blurred just after the intervention and is caused by contact glass pressure and methylcellulosis, transitory laser-induced increase in the IOP and mild iritis. Quick deterioration of the visual field is rare, but it does represent a rather serious complication that can be encountered in patients with advanced glaucoma and high IOP values prior to surgery. Small peripheral anterior synechiae appeared with a large number of posterior spots in patients with a narrow chamber angle. Later complications include a gradual increase in the IOP due to a smaller effect of the ALT treatment and a decrease of the efficiency subsequent to filtering surgery. Although there are not enough data to support this thesis, it has been shown that a three-fold higher

frequency of encapsulated filtering cushion after filtering surgery has been conducted in persons who had previously undergone ALT (10).

The major aim of our work is to assess how efficient and safe Argon laser trabeculoplasty is in open angle glaucoma therapy.

MATERIAL AND METHOD

Research conducted at the Clinic of Eye Diseases, Clinical Centre in Kragujevac in the period from January 1, 2004 to September 30, 2008 included 84 eyes from 49 patients who had been previously treated with medications and did not achieve a satisfactory control of IOP. The intervention was performed with a Zeiss Visulas 532 laser.

The inclusion criteria used in this study were, as follows: i) open angle glaucoma not treated by medications, according to the type of primary open angle glaucoma (POAG) and secondary open angle glaucoma (pseudoexfoliative glaucoma – PEX and pigmented glaucoma), ii) IOP > 22 mmHg, iii) age \geq 50, iv) a cup disc ratio of 0.5 or more, v) an asymmetry of the findings between two eyes > 0.2, vi) visual acuity > 0.2 and vii) phakic eyes.

The exclusion criteria were as follows: i) patients with progression of the cup disc ratio, ii) patients with advanced damage to their visual field, iii) IOP higher than 30 mmHg, iv) patients who previously had eye surgery, such as aphakia, pseudophakia and filtering surgery, v) patients expected to undergo some sort of ocular surgical intervention, vi) corneal illnesses preventing visualisation of the trabecular meshwork of chamber angle and a precise measurement of the IOP, vii) monocular patients, viii) high myopia, ix) patients who were on systemic or local corticosteroid therapy, and x) patients with illnesses that might require a corticosteroid treatment.

Before the treatment started, a detailed ophthalmology exam was performed, which included the following: i) the history of the current illness and the prior medication therapy that was used in order to determine the best corrected visual acuity, ii) the measurement of IOP by the Goldmann applanation tonometer, iii) biomicroscopy of the anterior eye segment, and iv) gonioscopy and stereoscopy of the optic nerve head and retinal nerve fiber layer in the biomicroscope by either the indirect method, which uses an indirect fundus lens (78D or 90D) or by the direct method, which uses the Goldmann 3-mirror or visual field charting on the Humphrey automated perimeter, respectively, using the 30-2 Threshold program.

Prior to intervention, each patient received 250 mg acetazolamide per os tbl in order to prevent a laser induced-increase of IOP. The intervention was performed with a topical anaesthetic, sol tetracain 0.5%, right before the treatment. ALT was performed using Goldmann contact glass with 3 mirrors and an anti-reflective layer. Methylcellulosis was used as a medium between the cornea and the glass. Having analyzed the elements of the chamber angle, the spot application was performed. The lower 180° chamber angle was treated clockwise, at the junction of the anterior non-pigmented and the posterior pigmented part of the trabecular meshwork. Fifty spots per patient were applied. The standard parameters were a spot size of 50 μ m and an exposition of 0.1 s, while the power was individually allocated within a 600- to 1,000-mW parameter until the desired effect, in the form of gas bubbles, appeared



or the eye became bleached where the laser was applied. Patients were given another tbl of 250 mg acetazolamide in the evening, followed by topical sol dexamethasone-neomycin four times per day for seven days in order to prevent a topical inflammatory reaction, which could be proceeded with running anti-glaucoma medication therapy. Periodic check-ups were scheduled for the first 24 hours, 1 month, 3 months, 6 months, 1 year, 2 years and 4 years after the treatment. During the scheduled periodic examinations, the visual field was examined with the Humphrey automated perimeter using the 30-2 Threshold program.

The success of the treatment was defined as IOP ≤ 21 mmHg, with no further progression of disc or visual field changes and a drop in the progression in the visual field.

Statistics were calculated with the statistics software, SPSS 10.0 for Windows XP, for descriptive statistics that included absolute numbers, average value and standard deviations. The Student's T-test was used for the comparison of the average values before and after the intervention.

RESULTS

Eighty-four eyes from forty-nine patients were analyzed. Fifty-one eyes had primary open angle glaucoma (72.6%), nineteen eyes had pseudoexfoliative glaucoma (22.6%) and four eyes had pigment glaucoma (4.8%). The average age of the patients was 64.65 ± 5.60 years (range = 54-73 years). Twenty-eight men (57.1%) and twenty-one women (42.9%) were examined. (Table 1.)

All patients had been previously treated with topical medication. Forty-eight eyes (57.1%) were treated with one medication, thirty eyes (35.7%) were treated with two medications and six eyes (7.1%) were treated with three medications. The average number of medications was 1.5 (SD 0.63). The average IOP value prior to Argon laser trabeculoplasty was 25.28 ± 1.56 mmHg (range = 23-29 mmHg). For 19 eyes (23.5%), the transitory IOP increase was < 4 mmHg. Peripheral anterior synechiae were detected in eleven eyes (13.6%), and a mild uveal reaction was detected in four cases (4.9%). One month after the intervention, the target IOP of ≤ 21 mmHg was achieved in 63 eyes (77.8%), where the average IOP value was 19.68 ± 2.26 mmHg (range = 16-24 mmHg). Three months after the treatment, the target IOP was recorded in 76 eyes (93.8%), with an average IOP value of 18.01 ± 1.87 mmHg (range = 16-23 mmHg). Six months after the treatment, the average IOP value was 17.4 ± 1.65 mmHg (range = 16-23 mmHg), and the target pressure was achieved in 76 cases (93.8%). One year after the intervention, a small decrease in the intervention efficiency was detected, with the target IOP achieved in 65 cases (80.2%) and an average IOP value of 17.96 ± 2.44 mmHg (range = 16-24 mmHg). Two years after the treatment, the average IOP value was 18.22 ± 2.65 mmHg (range = 16-24 mmHg), and the target IOP was reached in 61 eyes (75.3%). Due to an unresponsive IOP, filtering surgery was performed in one case (1.2%). At the end of the fourth year, the number of examined eyes amounted to 73, due to the fact that filtering surgery was performed on 8 eyes (9.9%) with unresponsive IOP. At this time, the average IOP value was 18.49 ± 2.95 mmHg (range = 16-24 mmHg), and the target IOP was achieved in 54 eyes (66.7%). (Table 2, Table 3.)

Table 1. Patient data

No. patients (eyes)	49 (84)
Age mean ± SD	64.65 ± 5.60
Sex	
Male	28 (57.1%)
Female	21 (42.9%)

Statistically, a significant decrease in the IOP was achieved when compared to the initial values one year after the treatment (7.32 ± 2.84 mmHg), two years after (7.16 ± 2.98 mmHg) and four years after (6.84 ± 3.33 mmHg) (p < 0.001, for all).

DISCUSSION

Many studies have proven that ALT is efficient in decreasing the IOP with open angle glaucoma. The criteria and percentage that show the success of the treatment after the first year of intervention has varied among the studies, with a range between 70-90%. Immediately after the intervention, ALT significantly reduced the IOP. Thomas et al. analyzed ALT efficiency in 1982, with a focus on patients who were on optimal drug therapy. Their study demonstrated that IOP was reduced by 6.4 mmHg (26%) five months after the treatment of 237 patients with POAG (11). In 1990, the Glaucoma Laser Trial Research Group has shown that a bigger reduction of IOP can be achieved with those patients who had ALT performed as the primary procedure. There was an average IOP reduction of 9 mmHg (33% three months after it was performed on 264 patients) (9).

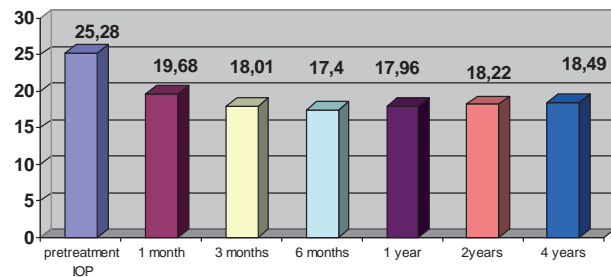


Table 2. Effect of ALT on IOP reduction in mmHg (mean ± SD)

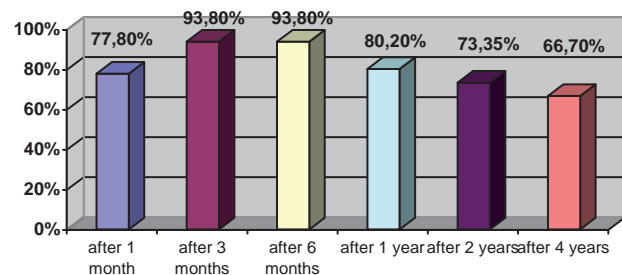


Table 3. Success rate of ALT (%)



Our research has found that the average IOP decreased by the following amounts: 1 year after treatment, 7.32 ± 2.84 mmHg; 2 years after treatment, 7.16 ± 2.98 mmHg and 4 years after treatment, 6.84 ± 3.33 mmHg. This is in agreement with the results obtained from Thomas et al. During the first week after the treatment, no serious complications were recorded. The most serious complication was a laser-induced rise of IOP, and it was detected in 19 eyes (23.5%) but was less than 4 mmHg in all cases. Our results do not record a significant laser-induced rise of IOP, which is contrary to the results of the Glaucoma Laser Trial Group, whose results showed that there was a relatively frequent IOP rise after ALT, with a rise of more than 5 mmHg in 34% of the cases and a rise of 10 mmHg in 12% of the cases. The patients who were treated for 180° of chamber angle were the ones who had the highest laser-induced IOP rise (12). These results should be clarified before and after the surgery, using acetazolamide on the very day of surgery, as well as with an IOP time measurement. Thus, control measurements of the IOP were taken one hour after the surgery. It is important to note that the frequency and complexity of IOP increases become higher, as more energy is used when there is a 360° chamber angle treatment with a more posterior position of the spot, with a higher pigmentation of the chamber angle and with a lower presurgical chamber liquid drainage (13). The increase in the IOP is most frequent 2 hours after the surgery, although a postponed IOP increase can also occur. Therefore, close monitoring of the patient is advised for four hours after the intervention. The mechanism behind the laser-induced increase in IOP has not been fully clarified, but it is assumed that it appears as a consequence of the trabecular meshwork being swollen or as an obstruction of trabeculatory swelling by debris. Topical use of corticosteroids cannot prevent it, nor can synthesis inhibitors of prostaglandins, while the use of synthesis blockers of the aqueous humour and α -2 agonist reduce the incidence of a laser-induced rise of IOP in almost 2/3 of all cases (14).

Peripheral anterior synechiae are present in a high percentage after ALT, but their appearance is of little clinical importance and has no influence on the reduction of IOP. In 13.6% of our cases, they appeared when higher energy was used and at more posterior spots. Post-laser uveitis is mild and rare. In our study, it appeared in 4.9% of all cases and was successfully treated with topical corticosteroid therapy.

There was also a positive effect that was noted with diurnal fluctuations of IOP in successfully treated patients (15).

Many studies have proven that the ALT effect decreases when IOP is reduced. Schwartz et al. have proven that the treatment was successful in 77% of patients for two years after the treatment but that the success decreased to 46% five years after the treatment (16). In 1996, Weireb et al. showed that ALT was efficient in 50% of the cases in a five-year study, with a decrease rate of 6-10% annually (17). Spaeth and Baez have come to the conclusion that only one-third of their patients displayed a satisfactory IOP reduction five years after the intervention. Efficiency decreases mostly during the first year and then gradually decreases by 10% annually (18). Our research has shown that one year after the intervention, the target IOP was achieved in 80.2% of patients, 2 years after the intervention in 75.3% and 4 years after in 66.7%, which is in agreement with previous data. Since the selection of patients does affect the success of the treatment, one of the criteria for inclusion in this study was an age of ≥ 50 . Persons who are younger than 40 years show a weaker effect on IOP reduction, have stronger post surgical inflammation and paradoxically have a prolonged IOP increase (19). The disparities due to age can be explained by the fact that age mellows the walls in Schlemm's canal and the trabeculoma, which responds better to the tightening of the inner traboculuar ring after ALT. The Advanced Glaucoma Intervention Study (AGIS) (20) has proven that unsuccessful ALT correlates with a younger age and a larger presurgical IOP value.

Our study has shown that ALT is a safe and effective method that can achieve a satisfactory reduction of the IOP in patients with open angle glaucoma who have not had success with drug therapy to target and reduce the IOP. The method is a simple out-patient procedure, which does not have any significant or long-lasting side effects or complications. ALT can postpone the need for filtering surgery for a high percentage of patients. After four years in our study, filtering surgery was only performed in eight cases (9.9%). Any undesired ALT side effects weaken over the course of time and limit the repetition of the treatment for one more application to the remaining 180° of the chamber angle due to structural changes in the trabecular meshwork chamber angle.





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