DIODE LASER TRABECULOPLASTY IN OPEN ANGLE GLAUCOMA:
50µ vs. 100µ SPOT SIZE

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Summary – The study was aimed at evaluating the efficacy of diode laser trabeculoplasty in lowering intraocular pressure in patients with both primary open-angle glaucoma and exfoliation glaucoma by using different size of laser spot. This six-month, unmasked, controlled, prospective study included sixty-two patients with the same number of eyes, who were divided into two groups. Trabeculoplasty was performed with 50 µ and 100 µ laser spot size in the group I and group II, respectively. Other laser parameters were the same for both groups: the wave length of 532 nm, 0.1 second single emission with the power of 600-1200 mW was applied on the 180 degrees of the trabeculum. The mean intraocular pressure decrease in the 50 µ group (group I) on day 7 was 24% from the baseline and after six-month follow-up period the intraocular pressure decrease was 29.8% (p<0.001). In the 100µ group (group II), the mean intraocular pressure decrease on day 7 was 26.5% and after six months it was 39% (p<0.001).

Key words: Trabeculectomy; Glaucoma, Open-Angle; Lasers, Semiconductor; Intraocular Pressure; Laser Therapy

Introduction

Laser trabeculoplasty is the effective therapeutic approach for intraocular pressure-lowering, as primary or adjunctive treatment. Different laser cores could be used for trabeculoplasty – Argon (ALT), Diode (DLT) and frequency doubled Nd:YAG, better known as Selective Laser Trabeculoplasty (SLT). SLT is equivalent to ALT in terms of intraocular pressure-lowering in primary open-angle glaucoma (POAG) one year after the treatment [1-3]. DLT and ALT are equally effective in lowering intraocular pressure (IOP) over a 5-year period [4]. There are studies confirming 25-30% of IOP decrease after laser trabeculoplasty. Within the first two years 56-80% of patients respond in the mentioned manner [2,5-7]. Three to five years after laser trabeculoplasty, a fading effect on IOP begins in some patients [8-10]. Laser trabeculoplasty can be used to treat the following open-angle glaucomas: POAG, exfoliation glaucoma (XFG) and pigmentary glaucoma. Laser trabeculoplasty is not indicated in angle-closure glaucoma, secondary glaucoma, juvenile glaucoma and in patients under the age of 40 (except in pigmentary glaucoma and XFG) [11].

The majority of DLT studies were done with 50 µ or 100µ laser spot size. They were performed with different exposure time, varying from 0.1-0.5 seconds. According to our knowledge, comparative studies were done with lasers of different wave lengths, usually comparing DLT and ALT or SLT. The data from comparative studies concerning magnitude of IOP decrease, six months after the DLT, are presented in Table 1.

Although argon laser trabeculoplasty guidelines recommend a 50 µ spot size, certain trabeculoplasty treatment recommendations for diode lasers suggest the larger spot size of 100 µ [12]. The purpose of this study was to use the same wave length, exposure time and energy, and to determine whether the difference in the laser spot size affected DLT outcome.

Material and methods

A six-month, unmasked, controlled, prospective study was conducted between January and June 2008. The IOP-lowering efficacy of DLT was compared in POAG and XFG patients. Sixty-two eyes (POAG=33, XFG=27) were included in the study. One eye of each patient was treated. All patients provided the informed consent. This study was approved by the Ethical Committee of Medical Faculty in Novi Sad, Serbia in 2007.

The inclusion criteria for patients were the age ≥ 30 years, subjects of both sexes, previously diagnosed POAG and/or XFG, treatment consisting of one to maximum three anti-glaucoma medications, average IOP value of 18-30 mmHg in at least two consecutive IOP measurements at 8 a.m., during the previous 2 months, using the Goldmann applanation tonometry.

The exclusion criteria were: no visual acuity (no light perception); angle measured by gonioscopy - grade less than 2 (Shaffer classification); C/D (cup/disc ratio) greater than 0.9; a history of chronic and recurrent inflammatory eye disease, severe retinal disease or any abnormality of the cornea preventing reliable applanation tonometry; and/or decrease of transparency; ocular trauma and eyes with prior filtering or cataract surgery. The patients with IOP remaining greater than 21 mmHg for 30 days after DLT were also excluded on the basis of potential safety risks. The patients with severely unstable or uncontrolled cardiovascular, hepatic and renal diseases, pregnancy or the history of significant hypersensitivity to α-agonists were also excluded.

The mean IOP on day 7 was 24% from the baseline, and after six-month follow-up period the intraocular pressure decrease was 29.8% (p<0.001). In the 100µ group (group II), the mean intraocular pressure decrease on day 7 was 26.5% and after six months it was 39% (p<0.001).

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The patients from both groups were administered anti-glaucoma drugs in the same number and of the same class (β-blockers, prostaglandin analogues or carbonic anhydrase inhibitors). There were no changes in medication during the follow-up period. The patients included in the study did not have laser trabeculoplasty before. The following eligibility evaluations were conducted and documented for each patient as diagnosis criteria: best corrected visual acuity better than 0.1 (log MAR scale), bio-microscopy, gonioscopy (open angle), detailed fundus examinations, cup ratio >0.4, and repeatable glaucoma visual field defects, which were not explained by other causes, with two or more points on Humphrey® automated perimetry, mean deviation (MD) range from -4 dB to -28 dB.

The α-agonists brimonidine 0.1% had been applied as topical premedication 40 minutes before the intervention. The DLT was performed with Zeiss Visulas 532s diode laser system, 0.1 second single emission of 600-1200 mW. A laser beam was applied through gonioscopy lens on the anterior third of trabecular meshwork (TM) using 12x bio-microscopy magnification. The DLT was limited on inferior 180º of trabecular meshwork, always making 40-50 burns and remaining 100 µ space between the neighbouring two. The laser power was adjusted for each patient according to trabecular tissue reaction end point, which was minimal blanching [13]. All patients were administered 1% dexamethasone qid 7 days after the DLT to prevent potential inflammatory reaction.

The eligible patients were enrolled into two treatment groups. One group (group I) was treated with DLT of 50 µ spot size and the other one (group II) with a 100 µ spot size. The follow-up examinations for safety and efficacy evaluations after DLT were done on days 7, 30, 90 and 180. The IOP measurements were taken at 8 a.m. The observers were masked when measuring IOP. Ocular side effects (blurred vision, ciliary hyperemia, iritis, elevated IOP) were documented during six months follow-up period on scheduled check-ups. Potential post-trabeculoplasty IOP spikes were not collected in the first 24 hours because the authors did not find them relevant enough in the final outcome of IOP decrease magnitude.

A statistical analysis was performed using Anova Data Analysis (ANOVA) and t-test in MS Excel with 95% confidence interval (CI). ANOVA was used to analyze the variance inside the 50 µ and 100 µ groups, comparing the baseline IOP with the values on day 7, 30, 90 and 180. The same method was used to compare the 50 µ group with the 100 µ group on the same control day. T-test was used to evaluate the age, gender, visual acuity, C/D and laser power.

Results

Two of sixty-two patients enrolled in the study were excluded (did not come for the scheduled check-up). Two groups were homogenous regarding sex, age, best corrected visual acuity, horizontal and vertical cup/disc ratio of optic nerve and baseline IOP. The average laser power was 767±133 mW and 770±57 mW (X±2SD) for the 50 µ group and 100 µ group, respectively.

In addition, there were no statistically significant differences of the baseline IOP: 23.58±2.89 mmHg and 22.51±2.57 mmHg in the 50 µ group and 100 µ group, respectively (p=0.1). Fluctuations of the IOP in both groups during six month follow-up period are shown as average values (Graph 1).

Graph 1. IOP fluctuations after DLT in open angle glaucoma during the six-month follow-up

**Graph 1. Fluktuacije IOP nakon DLT kod glaucoma otvorenom ugla u periodu od 6 meseci.**

In the 50 µ group, IOP on day 7 was reduced by 24% from the baseline (p=0.000922), on day 30 it was decreased by 30.8% from the baseline (p=6.21−6), on day 90 it was reduced by 31.4% from the baseline (p=1.78−5), and on day 180 it was decreased by 29.8% from the baseline (p=2−7).

In the 100 µ group, IOP on day 7 was reduced by 26.5% from the baseline (p=8.41−6), on day 30 it was decreased by 34.6% from the baseline (p=1.95−3), on day 90 it was reduced by 35.7% from the baseline (p=1.09−3) and on day 180 it was decreased by 39% from the baseline (p=5.51−3).

ANOVA data analysis shows statistically significant difference among the patients inside 50 µ group and 100 µ group, as well as between 50 µ group and 100 µ group (Table 2).

In the group treated with 50 µ laser spot, ciliary hyperemia was evident in two eyes on day 7. In the group treated with 100 µ laser spot, one eye did not show any change in IOP during the six-month follow-up period.
Discussion

In this prospective study, the efficacy and safety of DLT were evaluated in patients with POAG and XFG. No serious ocular side effects were documented after DLT.

The baseline IOP in the group treated with 100 µ laser spot was 1.0±0.3 mmHg lower than in the 50 µ group. After six months, the 100 µ group had 2.8±0.6 mmHg lower IOP. In our opinion, the small difference in the baseline IOP could not significantly affect the magnitude of IOP decrease. Both groups reached safe IOP in six months. The IOP was significantly lower than the baseline IOP levels in both groups on each check-up during the six-month period. The results of this study do not differ significantly from the results of other authors who used DLT or ALT (Table 1).

The Early Manifest Glaucoma Trial (EMGT) showed a 25% of IOP decrease from the baseline on day 90 [14]. That study was performed with ALT and 50 µ laser spots. Compared to EMGT, our study showed a slightly better result with 29.8% of IOP reduction from the baseline in the 50 µ group. Another study performed with 50 µ laser spots showed a 22% of IOP reduction from the baseline after six months [15].

In the 6-month SLT clinical trial of Damji et al. [1] the average IOP at baseline was 22.8 mmHg, 20.1 mmHg, 19.3 mmHg, and 17.8 mmHg in the first, third, and six month, respectively. In the ALT group, the average IOP at baseline was 22.5 mmHg, 19.5 mmHg, 19.6 mmHg, and 17.7 mmHg in the first, third, and six month, respectively. The SLT showed the IOP-lowering magnitude of 21.9% after 6 months; the similar was ALT with 21.3% decrease from the baseline. Compared to these results, better IOP-decrease was reached after 6 months, i.e. 29.8% in the 50 µ group and 39% in the 100 µ in our study. In this opinion, our difference can be explained by more XFG eyes in our study, which can give higher magnitude of IOP decrease than POAG eyes, due to the excessive pigmentation of trabeculum. Our study dealt with 45% of XFG eyes, compared to the study of Damji et al. in which there were 38% of XFG and pigmentary glaucoma in SLT group and 33% in ALT group. Our study showed a higher magnitude of IOP decrease in XFG eyes than in POAG eyes, in both 50 µ and 100 µ groups after 6 months.

Other SLT study of Lanzetta P et al. showed 39.9% of IOP decrease from the baseline after 6 weeks [16].

Conclusion

This study suggests that the diode laser trabeculoplasty is more effective when a 100 µ laser spot is used. Compared with 50 µ diode laser trabeculoplasty, the 100 µ laser treatment also shows more consistent reduction of the intraocular pressure during six months period and, possibly, afterwards. This study found a statistically significant difference in the reduction of the intraocular pressure between 50 µ and 100 µ treatment on day 7, 30 and 180. On day 90 there was no statistically significant difference between the groups.

References

Laserska trabekuloplastika je efikasan terapijski pristup u lečenju povećanog intraokularnog pritiska. U radu smo ispitivali efikasnost laserske trabekuloplastike na snižavanje intraokularnog pritiska kod glaukoma otvorenog ugla korišćenjem različite veličine laserske tačke.

**Materijal i metode**

Otvorena kontrolisana prospektivna studija u trajanju od 6 meseci. Uključeno 62 oka i isti broj pacijenata, u dvije jednake grupe. Trabekuloplastika je radena na diodnom laseru, u prvoj grupi sa tačkom veličine 50 µ a u drugoj grupi sa tačkom od 100 µ. Ostali laserski parametri bili su jednaki u obe grupe: talasna dužina 532 nm, snaga 600-1200 mW, ekspozicija 0,1 sekunda. Pacijenti su kontrolisani 7, 30, 90 i 180 dana nakon intervencije.

**Rezultati**

Dva pacijenta su isključena iz studije a samo kod jednog nije došlo do sniženja intraokularnog pritiska nakon 6 meseci od intervencije. Srednje sniženje intraokularnog pritiska u odnosu na početne vrednosti u prvoj grupi bilo je: 24% (7 dan) i 29,8% [p<0,01] (180. dan). U drugoj grupi sniženje intraokularnog pritiska bilo je 26,5% (7. dan) i 39% [p<0,01] (180. dan).

**Zaključak**

Ova studija je pokazala veću efikasnost u sniženju intraokularnog pritiska pri korišćenju laserske tačke od 100 µ.