

CLINICAL EFFICACY OF 810 NM LASER MICROPULSE TRABECULOPLASTIC SURGERY IN GLAUCOMA



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ГЛАУКОМА КАСАЛЛИГИДА 810 НМ ЛИ ЛАЗЕР ЁРДАМИДА ОЛИБ БОРИЛГАН МИКРОПУЛСЛИ ТРАБЕКУЛОПЛАСТИКА ЖАРРОҲЛИК АМАЛИЁТИНИНГ КЛИНИК САМАРАДОРЛИГИ

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КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ЛАЗЕРНОЙ МИКРОИМПУЛЬСНОЙ ТРАБЕКУЛОПЛАСТИЧЕСКОЙ ХИРУРГИИ С ДЛИНОЙ ВОЛНЫ 810 НМ ПРИ ГЛАУКОМЕ

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Резюме. Турли хил фармакологик гуруҳлардаги дори воситаларига қарши кўрсатмалар турли гуруҳларда такрорланмайди, бу эса маълум бир беморда бирга келадиган касалликларга қараб доволаш чора тadbирларини танлаш имконини беради. Бирламчи очиқ бурчакли глаукома касаллиги билан озриган беморларда циклофотокоагуляция жарроҳлик амалиётидан сўнг кўз ичи босимининг самарали пасайиши улуши ингичка шох пардаси бўлган кўзларда сезиларли даражада юқори бўлган усулдир. 810 нм ли лазер ёрдамида олиб борилган микропулсли трабекулопластика амалиёти самарадорлигини кўрсатувчи ягона омил бу кўз ичи босимининг дастлабки юқори даражасидир. Шунингдек, глаукомада қўлланиладиган 810 нм ли лазер ёрдамида олиб борилган микропулсли трабекулопластика ҳақидаги тавсиянома клиник ҳужжатлаштирилган маълумотлар билан энг долзарб маълумотларни тақдим этади ҳамда ушбу тавсияномани тиббиёт университети талабалари, ординатор ва магистрларга тавфсия этилади.

Калит сўзлар: глаукома, микропулсли трабекулопластика, 810 нм ли лазер.

Abstract. Contraindications to drugs of different pharmacological groups are not repeated in different groups, which allows for the selection of therapeutic measures taking into account concomitant diseases in a particular patient. In patients with primary open-angle glaucoma, cyclophotocoagulation is a method that has a significantly higher rate of effective reduction of intraocular pressure after surgery in eyes with thin corneas. The only factor indicating the effectiveness of laser micropulse trabeculoplasty with a wavelength of 810 nm is the initially high level of intraocular pressure. Also, the recommendation for laser micropulse trabeculoplasty with a wavelength of 810 nm for glaucoma is the most modern with clinically documented data. describes this recommendation to medical students, rectors and master's degrees.

Keywords: glaucoma, micropulse trabeculoplasty, 810 nm laser.

Introduction. With medical advances, lifestyles are improving, while the world's population is growing and the population is aging, increasing the risk of visual impairment. In 2000-2010, the increase in ophthalmology patients was 4-5% of the world population, and the annual increase was 7%. Rejuvenation of diseases such as cataract and glaucoma is a particularly noteworthy process. Today, among the world's population, we can meet 30-35-year-old patients with such diseases [22]. According to the results

of the study, 2.71 million people in the United States suffered from eye diseases in 2011, and the age range of these patients was between 70 and 79 years (31%). The American Academy of Ophthalmology estimates that by 2050, 7.32 million people in the United States may have eye disease [20]. Due to demographic changes in Asian countries, the number of people who need ophthalmological services was 437 million in 2010, and this indicator may increase to 827 million by 2030 [23].

Searching for new information about the etiopathogenesis of glaucoma in our modern society, which is developing more and more, is becoming one of the urgent problems today due to the increasing number of elderly people among the population of the countries of the world. According to statistics, by 2030, the number of glaucoma patients in the world is expected to increase to 210 million. Our study of population aging as a medical and social problem of global and national importance is one of the urgent problems of today's medicine. Medical workers should reduce the cost of the public budget by maintaining the labor activity of the elderly, primary open-angle glaucoma is one of the diseases that cause irreversible visual impairment, therefore, the study and treatment of glaucoma are urgent problems. is one.

Glaucoma is currently one of the leading causes of irreversible blindness. Looking at the data provided by the World Health Organization, in 2002, 161 million people in the world suffered from eye diseases, and nearly 37 million of them ended up with blindness.

According to the data of this organization, in 2010, the number of visually impaired patients increased by 77 percent. In 2010, 285 million cases of visual impairment were diagnosed, and 13.7% of patients were diagnosed with a thousand, unfortunately, the disease ended with complete loss of vision [2]. According to the results of scientific work carried out by several scientists, in 2013, the number of people aged 40-80 with glaucoma was 64.3 million, and by 2040, this figure will increase to 111.8 million people [19].

Primary open-angle glaucoma is a progressive multifactorial disease characterized by stage-stage progression and irreversible optic nerve damage. Despite the active search for alternative methods of neuroprotection, the only proven effective method of controlling the development of primary open-angle glaucoma remains drug therapy, laser treatment, or surgical intervention to reduce intraocular pressure [16].

As a result of regular exposure to many agents that reduce intraocular pressure, it can cause damage to the epithelium of the cornea and goblet cells of the conjunctiva, which can negatively affect the lipid layer of the tear film. The active ingredient of hypotensive drug itself can have a negative effect on the condition of the eye surface [4, 10, 11].

During long-term conservative treatment with antihypertensive agents to lower intraocular pressure, fibrosis occurs as a result of exposure-related metaplasia of the conjunctival epithelium, a decrease in the number of goblet cells, and as a result, an increase in the activity of fibroblasts, an increase in collagen synthesized by them [7]. Even after some surgical operations that are currently carried out for such cases, the above cases may occur. At the same time, surgery has a negative effect on the duration of hypotensive effects [21].

In addition to the toxic damage of the eye surface, long-term use of antihypertensive drugs leads to a decrease in the sensitivity of the mucous membrane, and as a result, the intended goal cannot be achieved. The widespread introduction of laser cyclophotocoagulation into clinical practice has allowed a new approach to the problem of glaucoma treatment. This method is gaining popularity among ophthalmic surgeons. This method is aimed at reducing intraocular pressure. Laser cyclophotocoagulation

is characterized by minimal invasiveness and minimal complications [1]. The non-invasiveness and simplicity of the technique of implementation are undeniable advantages of transscleral cyclophotocoagulation [2].

A lot of clinical experience has shown that significant disadvantages of transscleral cyclophotocoagulation have also been identified, which include insignificant hypotensive effect in the postoperative period and the occurrence of postoperative inflammatory processes. According to foreign authors, this method causes permanent hypotension (1-5% of cases), subatrophy of the eyeball (6.9-9%), decreased visual acuity (19-40%) and retinal detachment. such complications can be encountered [3].

The development of cyclodestructive interventions for the treatment of glaucoma began in the 30s of the last century. The first such interventions were cryocoagulation and beta-irradiation [5]. According to several authors, a similar cyclophotocoagulation technique was developed and put into practice using an aluminum garnet (Nd: YAG) laser with a wavelength of 1064 nm. This method had fewer side effects than previously described [6]. The 810 nm semiconductor diode laser became the standard device for performing transscleral cytophotocoagulation in the 1990s due to its relatively low level of complexity [9]. During this manipulation, the laser is passed over the sclera with a triad ("gliding technique"), so that the laser energy is transsclerally delivered to the outer pigment layer of the epithelium of the ciliary body. It should be noted that the thermal energy of laser light increases the risk of complications such as iridocyclitis, hyphema, hemophthalmia, uveitis, endothelial-epithelial corneal dystrophy, hypertension, hypotension up to subatrophy of the eyeball, vision loss, and sympathetic ophthalmia [20]. Failure to control laser energy, the presence of serious liver diseases in the patient's anamnesis can lead to similar complications. Experiments carried out in rabbits revealed that complications such as hypotension and subatrophy of the eyeball, postoperative ischemia after transscleral surgery are caused by thrombosis of the vessels of the ciliary body [13]. Taking into account the above circumstances, it is appropriate to use this method in refractory glaucoma with low visual acuity.

In the 90s of the last century, Martin Uram proposed the endoscopic cyclophotocoagulation method, which is performed through the eye, which provides better visualization and, as a result, direct photocoagulation of the ciliary body under endoscopic control [23]. The endoscopic cyclophotocoagulation method is characterized by fewer complications compared to traditional transscleral cyclophotocoagulation due to the ability to selectively deliver laser energy to the ciliary body more gently [8]. From a clinical point of view, the endoscopic cyclophotocoagulation method also has technical difficulties, we should consider it as an invasive method associated with the risk of irreversible hypotension.

Mechanism of implementation of transscleral cyclophotocoagulation. In this process, high-intensity laser energy is continuously delivered to the ciliary body. Despite the fact that transscleral cyclophotocoagulation is an effective method in the treatment of glaucoma, it can be used as a last resort due to the risk of serious irreversible complications, such as a sharp decrease in visual acuity, hypotony, subatrophy of the eyeball. [17,18,19]. We can

evaluate these complications as a result of damage to surrounding healthy tissues due to the spread of thermal energy [22]. Obstacles arising from the use of traditional surgical methods motivate scientists and practitioners to create new technologies. A special probe is used during the application of the micropulse transscleral cyclophotocoagulation method, in this method an ultrashort laser beam is used, which has "on and off" modes. In the "On" method, rays with a wavelength of 810 nm are absorbed by melanins of the epithelium of the ciliary body. In "Off" mode, the equipment cools down and protects against thermal damage [10]. Due to this approach, which allows for more precise control of photothermal efficiency, the surrounding tissues are less damaged and, as a result, the risk of complications is reduced while maintaining the hypotensive effect [14,15].

The purpose of the scientific work. Evaluation of quality of life and determination of clinical effectiveness after trabeculoplasty performed with 810 nm laser in patients with glaucoma

Materials and methods. 200 glaucoma patients aged 40 to 78 years were involved in our research, 150 of them underwent laser surgery (150 eyes), 96 of these patients were women (48%), and 104 were men (52 %) does. All 200 patients (200 eyes) had an open and moderately wide anterior chamber angle during gonioscopy. According to the degree of trabecular pigmentation, patients were divided into 4 groups: Weak (I) in 58 pairs of eyes, Moderate (II) in 78 pairs of eyes, Pronounced (III) in 42 pairs of eyes, Severely expressed (IV) in 22 pairs of eyes. Of these patients, 50 patients were recruited with micropulse transscleral cyclophotocoagulation surgery (wavelength - 810 nm), and 50 patients were recruited with micropulse transscleral trabeculoplasty surgery (wavelength - 577 nm).

In order to achieve the goal, in order to ensure permanent myosis in all patients scheduled for surgery, 1% pilocarpine hydrochloride solution was dripped bilaterally 30 minutes before the operation. 5 minutes before laser surgery, it is dripped bilaterally with 0.5% alkaine solution.

Immediately after the surgical procedure, an anti-inflammatory nosteroid drug was instilled into the operated eye for prophylactic purposes once (Diclofenac 0.1%), similar drugs were used to prevent complications that could occur to all patients for a week after the operation.

It is carried out by exposure to the ciliated body with high-intensity laser energy. Although this surgical procedure is an effective way to lower intraocular osmi in glaucoma, it is most commonly used as a last resort due to the risk of serious complications such as decreased vision, hypotension, sympathetic ophthalmia and subatrophy of the eyeball. Other surrounding tissues can also be damaged by the effects of thermal energy.

The technology affects the lash-like body in a repetitive "On" and "Off" way with an ultra-short laser wave in the activated and deactivated order. During the "On" period, the ciliated body is affected by light pulses with a wavelength of 8-10 nm, and melanin is absorbed by the pigment epithelium. During the "Off" period, the surrounding tissues cool down and their thermal damage is removed. With this method, the surrounding tissues are less affected, and as a result, in combination with hypotensive efficiency, other complications are obtained.

✓ The "On" period is 0.5 m, the SEC "Off" period is 1.1 m. SEC continues.

✓ Energy capacity ranges from 1,600 MW to 2,000 MW-often up to 2,000 MW.

✓ In order not to damage the vascular and nerve structure of the ciliated body, movement is carried out from the side of the patient's foot along the trellis of the clock at 180 or 360 degrees.

✓ This surgical procedure with the help of a laser beam is carried out for a period of 100 to 360 seconds.

During the research conducted by us, this procedure was performed according to the instructions in the third stage of open-angle glaucoma, with an intraocular pressure of 35 mm.sim.us. we used it in cases above.

All of the patients we studied were examined at baseline and after 6 months. When a change to drug therapy was necessary after surgery, the choice of medication was made during the hospitalization period, and further recommendations for adherence were given in the outpatient phase. The effectiveness and tolerability of therapy, as well as the dosage of drugs and the medical effectiveness of the drug were evaluated at the control visit of the patients. Decisions were made to hospitalize patients and change therapy in emergency situations. After a long course of treatment, a control examination was carried out with recommendations for a change of therapy (if necessary) and an outpatient phase.

Results. Current micropulse transscleral cyclophotocoagulation is performed using a diode laser with a wavelength of 810 nm, which has the advantage of good absorption by melanin pigment. The results of some research conducted so far show that the ciliary body cannot be destroyed directly. In 2016, S. Line and co-authors performed ultrasound biomicroscopy of the limbal zone before and after treatment during their research, and found that, despite the clinical decrease in IOP level, no significant morphological changes were observed in the ciliary body.

After absorption of the light wave, the heat dissipation from the continuous pulse is regulated by the thermal properties of the affected tissue.

It was found that 50 patients who underwent surgery had a subcompensation stage of ophthalmotonus in conservative therapy. Using perimetry, in most cases, the changes typical of glaucoma were detected. Means and standard deviations are presented to show the stepwise variation in values for primary open-angle glaucoma disease severity stages. When determining significant differences between variance series of selected groups using the Kruskal-Wallis method, H values corresponding to a significance level of $p < 0.05$ were obtained, which were then analyzed using Student's test (t-).

50 patients who underwent micropulse transscleral cyclophotocoagulation had primary open-angle glaucoma for an average of 4.8 ± 2.6 years. 50 patients (100 %) had glaucoma and were treated in an outpatient setting, 9 patients (18 %) had this disease for the first time, 15 patients had stage I (30 %) of the disease, 24 patients (48 %) had stage II and In 11 patients (22%), the III stage of the disease was detected.

Table 1. Clinical examination

| Indicators | I (n=15) | II (n=24) | III (n=11) | t, p | |
|-------------------|------------|-------------|------------|------------------|-----------------|
| | | | | I и II | II и III |
| Pt | 23,3±1,2 | 25,21±1,30 | 25,34±1,38 | 2,01; <0,05 | 8,10; <0,05 |
| Po | 18,9±1,70 | 21,0±1,02 | 21,85±1,02 | 2,12; <0,05 | 6,01; <0,05 |
| Potl | 16,01±1,2 | 16,10±1,21 | 16,01±0,76 | 2,78; <0,05 | 2,35; <0,05 |
| Visual acuity | 0,77±0,13 | 0,69±0,11 | 0,51±0,9 | 5,61; <0,05 | 4,97; <0,05 |
| General view area | 489,19±2,3 | 404,85±3,61 | 303,8±7,29 | 209,92; <0,05 | 90,03; <0,05 |

Table 2. Tonometric indices in patients who underwent micropulse trabeculoplasty surgery

| Follow up time | I (n=15) | II (n=24) | III (n=11) |
|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Tonometry before the operation | 25,31±1,11 | 24,92±1,29 | 27,04±1,32 |
| 1 month later | 18,02±1,9 (t=27,5; p<0,05) | 18,02±1,21 (t=31,0; p<0,05) | 19,13±1,23 (t=34,10; p<0,05) |
| 3 months later | 17,91±1,1 (t=25,22; p<0,05) | 18,05±1,24 (t=29,14; p<0,05) | 21,05±1,1 (t=24,1; p<0,05) |
| 6 months later | 16,01 ±1,12 (t=26,2; p<0,05) | 18,88±1,43 (t=27,7; p<0,05) | 21,0±1,9 (t=18,95; p<0,05) |
| 12 months later | 17,14±1,52 (t=33,4; p<0,05) | 17,05±1,51 (t=27,5; p<0,05) | 21,8±1,3* (t=21,24; p<0,05) |

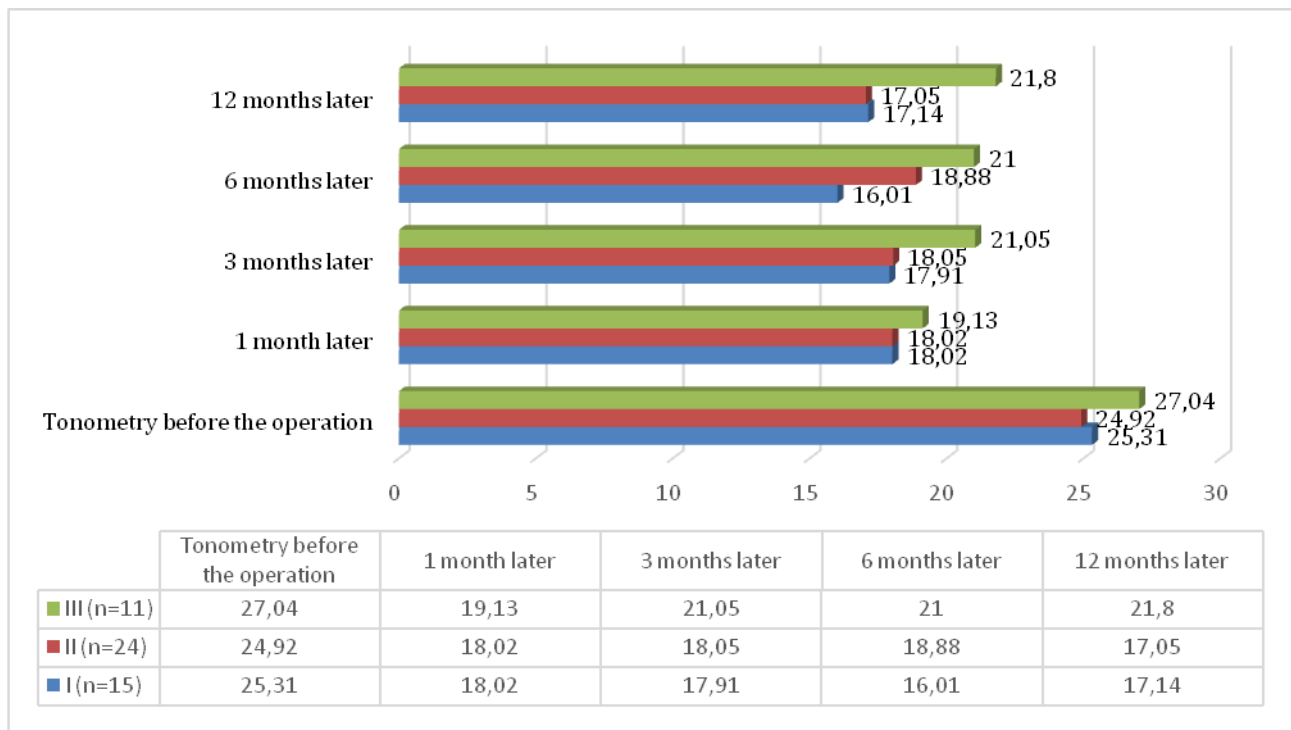


Fig. 1. The results of periodic tonometry are shown

Before laser surgery, all patients were selected for antihypertensive therapy to reduce IOP: monotherapy with 0.004% Travoprost solution in the form of 1 drop was used in the evening; In addition to Travoprost solution, combination with 0.5% Timolol solution, 1 drop 2 times a day; Instillation of 0.004% solution of Travoprost, 1 drop in the evening together with 1% solution of Brinzolamide 1 drop 2 times a day and 0.5% solution of Timolol 1 drop 2 times a day. A combination with a 1% solution of brinzolamide 1 drop 2 times a day or other combinations of antihypertensive drugs ensured a decrease in IBP.

After the laser surgery, the patients were immediately instilled NYQ drugs into the operated eye for the purpose of prevention. In order to prevent inevitable complications, these drugs were prescribed to all 50 patients in certain doses for 7 days after the operation. On the first day after the operation, 2 patients (4%) had light hyperemia of the conjunctiva, this condition lasted for 5-6 days, and the sensation of the foreign body in the patient's eye disappeared. This condition was eliminated without the use of additional treatment measures. At the same time, on the first day after the procedure, 3 (6%) patients had a

reactive increase in intraocular pressure up to 5.3 ± 1.0 mm.Hg. No further complications were detected after surgery.

The results of periodic tonometry are shown in the diagram in Fig. 1. The given information is shown to be reliable in 95% of cases. As can be seen from this figure, all stages after the surgery are characterized by a statistically significant decrease in intraocular pressure ($p < 0.05$). It was found that the stability of intraocular pressure is maintained in I and II stages of the disease. In the III stage of the disease, an increase in IOP was observed statistically 3 months after surgery ($p < 0.05$), and when examining patients in this group after one year, it was found that the IOP significantly decreased. It was found that the differences between the groups separated by disease stages are significant ($p < 0.05$).

6 months after the laser surgery, an increase in intraocular pressure was noted in 3.0% of patients in the III stage of the disease and receiving combined antihypertensive therapy. In order to reduce the intraocular pressure in these patients and to stabilize the course of the disease, two patients underwent reoperation. According to the results of non-parametric variance analysis, statistically significant trends ($p < 0.05$) were observed in their improvement.

One effective randomized trial comparing the effectiveness of group 2 patients with glaucoma was M.C. Aquino, K. Barton, A.M. Conducted by Tan. As a result of this study, the number of antihypertensive drugs used by the patients decreased from 2 on average. After one and a half years, no statistically significant difference between the groups was found.

Currently, in practical medicine there are many hypotensive agents that reduce IOP, but conservative treatment methods are less effective because there are several factors that influence treatment. Patients' forgetting to use eye drops, the high cost of drugs, and the decrease in the effect of drugs reduce the effectiveness of treatment. In such conditions, it is impossible to achieve normal IOP, which causes a number of problems in clinical research.

Thus, trabeculoplasty with 810 nm laser is considered to be one of the effective and safe alternative methods in terms of reducing the IOP level and the number of antihypertensive drugs used in glaucoma patients. Further studies are needed to establish the relationship between laser settings and treatment success in order to standardize this technology and to make it more widely available in clinical practice. Long-term evaluation of the hypotensive effect of these procedures requires large comparative studies. In stages I and II, the level of IOP that does not exceed the target pressure value is observed. It was found to be a statistically significant parameter ($p < 0.05$) for the increase of intraocular pressure in the III stage of open-angle glaucoma. The differences in IOP between groups were statistically significant ($p < 0.05$).

No significant improvement of visual acuity was found in all stages of the disease ($p > 0.05$). A statistically significant ($p < 0.05$) positive dynamics of changes in the total limits of the field of vision in patients with open-angle glaucoma in the I, II and III stages has become a gratifying situation. All groups showed a significant difference in terms of disease stages ($p < 0.05$). During the analysis of visual acuity parameters within 12 months after the operation, negative dynamics were not detected in all

patients with glaucoma stages I and II, and statistically significant differences were not detected in patients with the disease III stage ($p > 0.05$).

Summary:

1. The dynamics of antihypertensive cancellation after micropulse trabeculoplasty with an 810 nm laser depends on the stage of primary open-angle glaucoma: 12 months after the operation, the number of patients receiving combined therapy with antihypertensive drugs decreased, the number of patients on monotherapy increased significantly, and in some patients with stage I and II, it was possible to completely avoid taking antihypertensive drugs in open-angle glaucoma ($p < 0.001$).

2. In patients with primary open-angle glaucoma, it was found that the clinical results (IOP, the sum of the peripheral limits of the visual field, etc.) were significantly improved after Micropulse trabeculoplasty surgery with 810 nm laser, depending on the stage of the disease. ($p < 0.05$). In stage I patients, better indicators of eye hydrodynamics and computer perimetry were noted than in patients in stage II and III of primary open-angle glaucoma. After selective laser trabeculoplasty for all stages, there was a statistically significant reduction of IBD against the background of drug treatment. In stages I and II, the level of IOP did not exceed the tolerable pressure value ($p < 0.05$), and no significant changes in visual acuity were detected ($p > 0.05$).

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КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ЛАЗЕРНОЙ МИКРОИМПУЛЬСНОЙ ТРАБЕКУЛОПЛАСТИЧЕСКОЙ ХИРУРГИИ С ДЛИНОЙ ВОЛНЫ 810 НМ ПРИ ГЛАУКОМЕ

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Резюме. *Противопоказания к препаратам разных фармакологических групп не повторяются в разных группах, что позволяет осуществлять подбор лечебных мероприятий с учетом сопутствующих заболеваний у конкретного пациента. У больных первичной открытоугольной глаукомой циклофотокоагуляция является методом, имеющим значительно более высокую скорость эффективного снижения внутриглазного давления после операции на глазах с тонкой роговицей. Единственным фактором, указывающим на эффективность лазерной микроимпульсной трабекулопластики с длиной волны 810 нм, является исходно высокий уровень внутриглазного давления. Также рекомендация по проведению лазерной микроимпульсной трабекулопластики с длиной волны 810 нм при глаукоме является наиболее современной с клинически документированными данными. описывает эту рекомендацию студентам медицинских вузов, ректорам и магистрам.*

Ключевые слова: *глаукома, микроимпульсная трабекулопластика, лазер с длиной волны 810 нм.*