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### ГЛАУКОМА КАСАЛЛИГИДА ЛАЗЕРЛИ ТРАБЕКУЛОПЛАСТИКА ЖАРРОҲЛИК АМАЛИЁТИНИНГ КЛИНИК САМАРАДОРЛИГИ

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### КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ЛАЗЕРНОЙ ТРАБЕКУЛОПЛАСТИЧЕСКОЙ ХИРУРГИИ 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 тадбирларини танлаш имконини беради. Бирламчи очиқ бурчакли глаукома касаллиги билан оғриган беморларда лазерли трабекулопластика жарроҳлик амалиётидан сўнг кўз ичи босимининг самарали пасайиши улуши ингичка шох пардаси бўлган кўзларда сезиларли даражада юқори бўлган усулдир. Лазерли трабекулопластика (ЛТП) амалиёти самарадорлигини кўрсатувчи ягона омил бу кўз ичи босимининг дастлабги юқори даражасидир.

**Калит сўзлар:** глаукома, лазерли трабекулопластика.

**Abstract.** Contraindications to drugs of different pharmacological groups are not repeated in different groups, which allows for the selection of therapeutic measures depending on concomitant diseases in a particular patient. In patients with primary open-angle glaucoma, laser trabeculoplasty is a method that provides a significantly higher level of effective reduction in intraocular pressure after surgery on eyes with a thinner cornea. The only factor indicating the effectiveness of laser trabeculoplasty is the initially high level of intraocular pressure.

**Keywords:** glaucoma, laser trabeculoplasty.

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**Introduction.** 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. Studying the aging of the population 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 expenditure from the public budget by maintaining the labor activity of the elderly, one of the diseases that cause irreversible vision impairment is primary open-angle glaucoma, therefore, the study of primary open-angle glaucoma and treatment of the disease is one of the urgent problems.

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 most of these patients were between the ages of 70 and 79 (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].

Hozirgi vaqtda glaukoma kasalligi ijtimoiy ahamiyatga ega bo'lgan kasalliklar orasida asosiy o'rinni egallamoqla, chunki bu tiklab bo'lmaydigan

koʻrlikning asosiy sabablaridan biridir. Butun jahon sogʻliqni saqlash tashkiloti bergan maʼlumotlariga nazar tashlaydigan boʻlsak, dunyoda 2002 yilda 161 million kishi koʻrish aʼzolari kasalliklari bilan ogʻrigan, shundan qariyb 37 million holatda koʻrlik bilan yakunlangan.

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

Primary open-angle glaucoma is a progressive multifactorial disease characterized by progressive and irreversible damage to the optic nerve. 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 the level of intraocular pressure [16].

Laser surgery methods in open-angle glaucoma are traditionally divided into laser goniotomy and trabeculoplasty methods. To date, the most widely used laser trabeculoplasty, especially laser trabeculoplasty technique [11]. According to the recommendations of the European Glaucoma Society, laser trabeculoplasty in patients with high-risk open-angle glaucoma, pseudoexfoliative glaucoma, pigmentary glaucoma and ophthalmic hypertension cannot be managed with conservative treatment methods due to the low efficacy of medical drugs. Recommendations also indicate the possibility of using laser trabeculoplasty as an initial method. In clinical practice, laser treatment is traditionally performed immediately after attempts to lower intraocular pressure with topical antihypertensive agents [3, 10].

The laser trabeculoplasty method was first discovered in 1983 by Anderson et al. when the tissue was exposed to laser light, pigment cells of the latter selectively absorb the radiation energy and thus limit the thermal damage caused by the laser [13]. Two conditions must be met for the photothermolysis effect to appear. First, cells must contain an intracellular chromophore that has a higher optical absorption of a laser of a certain wavelength than the surrounding tissue. Secondly, during the medical procedure, the laser light should not reach the level of thermal burns of the tissues, and as a result, it should not cause side effects [21]. The laser trabeculoplasty method proposed by Latina et al met the two criteria mentioned above. Thus, the method not only reduces the effect of heat on trabecular tissue, but it also affects the pigmented cells of the trabecula without damaging its structure [1].

Mechanisms of action of laser trabeculoplasty are still not well studied. Currently, it is considered that the therapeutic effect is achieved through biostimulation of the trabecular tissue at the mechanical level of the laser [8].

When studying the samples of the scientific studies conducted by various authors, serious changes of various degrees were returned when the samples of eye tissues of several patients who underwent laser trabeculoplasty were examined. Still another group of authors describes the damage of trabecular endothelial cells only, possibly as a

result of the rupture of cytoplasmic pigment granules [15]. Thus, histological studies confirm the existence of a mechanical component of the effect of laser radiation, while it is assumed that the degree of tissue damage depends on the applied energy dose. Proposed biological changes: secretion of cytokines, induction of matrix metalloproteinases, acceleration of cell division, stimulation of the movement and activity of macrophages under the influence of laser light [18].

In all cases, the method of laser trabeculoplasty cannot reduce the intraocular pressure. Many studies have been conducted to look for factors that help predict the success of medical treatment in certain patients. The available information is inconsistent [4]. For example, according to the opinion of some scientific researchers, as a result of the research, laser trabeculoplasty does not return the efficiency that can be achieved in elderly patients [6]. Amml, the authors of the only randomized study on the above-mentioned issue, reported that the success of laser trabeculoplasty did not depend on the age of the patients, gender, risk factors for glaucoma, type of primary open-angle glaucoma disease, and the level of pigmentation of the trabecular meshwork [9]. Also, no correlation was found in pseudophakic patients [16].

After laser trabeculoplasty in patients with primary open-angle glaucoma, the percentage of effective reduction in IOP was significantly higher in eyes with thinner corneas [17]. According to the opinion of scientists who have conducted some scientific research, previous medical procedures do not affect the effectiveness of laser trabeculoplasty, but there are ideas that contradict these opinions [14]. The only factor that indicates the effectiveness of the laser trabeculoplasty procedure is the initial high level of intraocular pressure [12].

In some cases, laser trabeculoplasty cannot be used, these include: post-inflammatory (secondary) glaucoma, congenital glaucoma, poor visualization of the anterior chamber angle [1].

The interaction of antihypertensive drugs with drugs used by patients for the treatment of general diseases should be used with caution, especially in patients with cardiovascular pathology. Currently, this problem has become one of the urgent issues of modern medicine [7].

Contraindications to drugs of different pharmacological groups are not repeated in different groups, which allows for the selection of treatment measures depending on the accompanying diseases in a given patient. During pregnancy and lactation, laser trabeculoplasty may be the most appropriate treatment method.

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

**Materials and methods.** 200 patients aged 40 to 78 years with glaucoma were included in our research, 150 of them underwent laser surgery (150 eyes), 96 of these patients were women (48%), and 104 were men (52 %) does. In all 200 patients (200 eyes), the anterior chamber angle was open and moderately wide 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, severe (IV) in 22 pairs of eyes. From these patients, 1st group was formed using laser

trabeculoplasty surgical method (wavelength - 532 nm), 50 patients were recruited into 2nd group and 50 patients were recruited using micropulse transscleral cyclophotocoagulation surgical procedure (wavelength - 810nm), 50 patients were also included into 3rd group. patients were recruited and treated using micropulse transscleral trabeculoplasty (wavelength - 577 nm).

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

Immediately after surgery, a non-steroidal anti-inflammatory drug (Diclofenac 0.1%) was instilled into the operated eye for the purpose of prevention, and the same drugs were administered to all patients for one week after the operation to prevent complications. After laser trabeculoplasty surgery, all patients were left on intraocular pressure-lowering drugs at the preoperative dose for one month, and according to the results of the next dynamic ophthalmological examination, the use of intraocular pressure-lowering drugs was stopped by the doctor.

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.

The results of the analysis of the pigmentation of the trabecular network of Schlemm's canal in all patients with primary open-angle glaucoma are presented in table 1.

The differences between the average values of RGB indicators for the weak and moderate levels of the identified pigmentation are statistically significant: in the R value ( $t = 6.4$ ;  $p < 0.001$ ), in the G value ( $t = 5.7$ ;  $p < 0.001$ ) and in the B value ( $t = 4.5$ ;  $p < 0.001$ ). The most obvious difference was in the R value.

Significant differences were noted in the RGB values between the average and clearly expressed pigmentation indicators: R value ( $t = 3.8$ ;  $p < 0.001$ ), G value ( $t = 4.6$ ;  $p < 0.001$ ).) and in the value of B ( $t = 5.4$ ;  $p < 0.001$ ). The clearest difference was found in indicator B.

**Table 1.** Photocolorimetric analysis mean values of trabecular pigmentation levels in all primary open-angle glaucoma patients were as follows

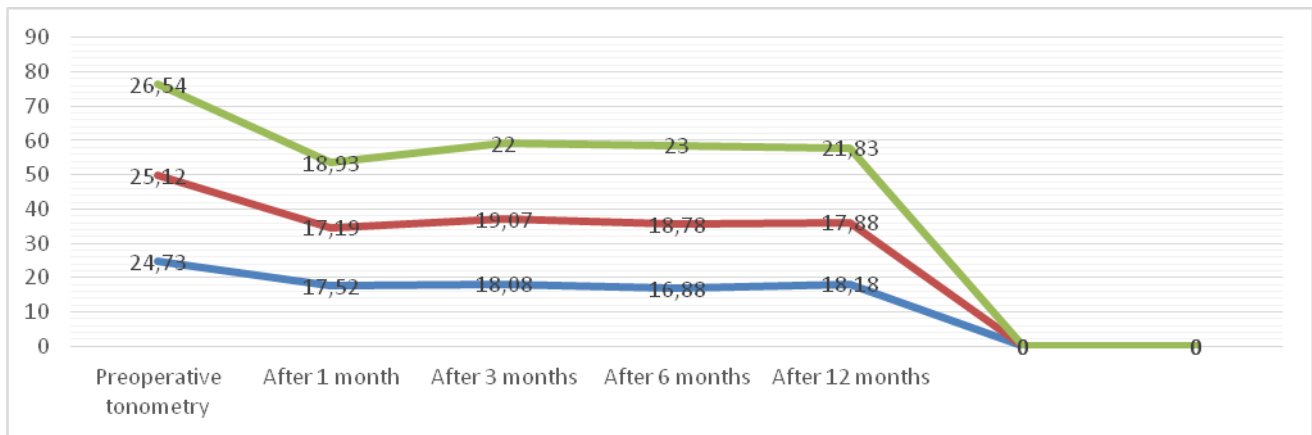
Trabecular pigmentation degree	Photocolorimetric analysis results			
	R	G	B	Color
	M±σ	M±σ	M±σ	
Weak (I) in 58 pairs of eyes	240,9 ± 19,5	209,8 ± 29,5	177,3 ± 33,1	
Average (II) 78 pairs of eyes	188,5 ± 32,6	152,9 ± 29,8	131,9 ± 27,2	
Clearly expressed (III) in 42 pairs of eyes.	135 ± 38,7	102,7 ± 28,4	87,8 ± 19,5	
Sharply expressed (IV) in 22 pairs of eyes.	83 ± 20,8	72,4 ± 27,3	56,5 ± 27,9	

**Table 2.** Clinical examination

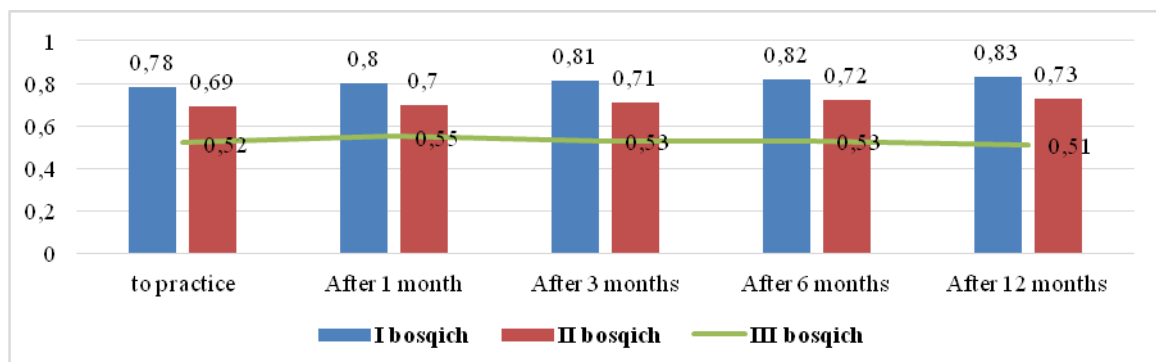
Ko'rsatgichlar	I (n=13)	II (n=27)	III (n=10)	t, p	
				I и II	II и III
Pt	24,73±1,18	25,12±1,31	26,54±1,47	2,01;<0,05	8,10;<0,05
Po	19,80±1,70	20,30±1,44	22,25±1,89	2,12;<0,05	6,01;<0,05
Potl	15,95±1,15	16,40±1,04	15,80±0,88	2,78;<0,05	2,35;<0,05
Visual acuity	0,78±0,12	0,67±0,14	0,52±0,19	5,61;<0,05	4,97;<0,05
General view area	500,18±2,33	404,85±3,61	304,57±7,32	209,92;<0,05	90,03;<0,05

**Table 3.** The clinical effectiveness of laser trabeculoplasty surgery

Time of observation	I (n=13)	II (n=27)	III (n=10)
Tonometry before the operation	24,73±1,18	25,12±1,31	26,54±1,47
1 month later	17,52±2,03 ( $t=28,95$ ; $p<0,05$ )	17,19±1,22 ( $t=32,9$ ; $p<0,05$ )	18,93±1,41 ( $t=33,90$ ; $p<0,05$ )
3 months later	18,08±1,9 ( $t=29,38$ ; $p<0,05$ )	19,07±1,52 ( $t=29,14$ ; $p<0,05$ )	22,0±1,4 ( $t=25,71$ ; $p<0,05$ )
6 months later	16,88 ±1,81 ( $t=30,3$ ; $p<0,05$ )	18,78±1,62 ( $t=28,47$ ; $p<0,05$ )	23,0±1,89 ( $t=18,95$ ; $p<0,05$ )
12 months later	18,18±1,45 ( $t=37,34$ ; $p<0,05$ )	17,88±1,61 ( $t=28,95$ ; $p<0,05$ )	21,83±1,23* ( $t=22,52$ ; $p<0,05$ )



**Fig. 1.** The results of periodic tonometry are illustrated



**Fig. 2.** Clearly shows the dynamics of visual acuity at various stages

The difference between the average values of RGB indicators for clearly expressed and strongly expressed levels of pigmentation was also found to be statistically significant: for R value ( $t = 3.27$ ;  $p < 0.001$ ), for G value ( $t = 2.08$ ;  $p < 0, 05$ ) and by B value ( $t = 2.3$ ;  $p < 0.05$ ). The clearest difference was found in the R value.

In 50 patients who underwent laser trabeculoplasty surgery, it was found that there is a subcompensation stage of ophthalmotonus in antihypertensive therapy. Using perimetry, in most cases, the changes typical of glaucoma were detected. Table 2 presents clinical examination data of 50 patients selected for group 1 according to stages of primary open-angle glaucoma disease before LT. 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 the variance series of the selected groups using the Kruskal-Wallis method, H values corresponding to the significance level of  $p < 0.05$  were obtained, which were then analyzed using the Student's test (t-).

50 patients who underwent laser trabeculoplasty surgery had primary open-angle glaucoma for an average of  $4.0 \pm 2.2$  years. 50 patients (100%) had glaucoma and were treated in an outpatient setting, 9 patients (18%) were diagnosed with this disease for the first time, 34 patients had stage I disease (68%) and 16 patients (32%) had stage I disease. Phase II has been identified. lazerli trabekuloplastika jarrohlik amaliyotidan oldin barcha bemorlar KIBni kamaytirish uchun antigipertenziv terapiya uchun tanlangan: 0,004% Travoprost eritmasi bilan monoterapiya 1 tomchi shaklida kechqurun qo'llanilgan; Travoprost eritmasiga qo'shimcha ravishda 0,5% Timolol eritmasi bilan kombinatsiyasi, kuniga 2 marta 1 tomchi;

Travoprostning 0,004% eritmasini tomizish, kechqurun 1 tomchi Brinzolamidning 1% li eritmasi bilan birgalikda kuniga 2 marta 1 tomchi va Timololning 0,5% li eritmasini kuniga 2 marta 1 tomchi tomiziladi. Brinzolamidning 1% eritmasi bilan kombinatsiya kuniga 2 marta 1 tomchi yoki antigipertenziv dorilarning boshqa kombinatsiyalari KIB ni pasayishini taminladi.

Patients who underwent laser trabeculoplasty surgery were immediately instilled nonsteroidal anti-inflammatory drugs into the operated eye for the purpose of prevention. In order to prevent possible complications, these drugs were prescribed to all 50 patients in certain doses for a week 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 a 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 laser trabeculoplasty, 3 (6%) patients had a reactive increase in intraocular pressure up to  $5.3 \pm 1.0$  mm.Hg. No further complications were detected after surgery.

The clinical effectiveness of laser trabeculoplasty surgery was determined by three main functional indicators: normalization of intraocular pressure, stabilization of visual field sharpness.

The results of periodic tonometry are illustrated in the diagram in Figure 1. It is shown that the given information is reliable in 95% cases. As can be seen from this figure, all stages after LT surgery are characterized by a statistically significant decrease in intraocular pressure ( $p < 0.05$ ). It was found that the stability of intraocular pressure was maintained in the 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 the patients in this group were examined one year later, 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 trabeculoplasty surgery, an increase in intraocular pressure was noted in 4% of patients who were in the III stage of the disease and were using combined antihypertensive therapy. In order to reduce the intraocular pressure in these patients and to stabilize the course of the disease, laser trabeculoplasty was performed again in two patients. According to the results of non-parametric variance analysis, statistically significant trends ( $p < 0.05$ ) were observed in their improvement.

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. Currently, the treatment of glaucoma with the help of laser trabeculoplasty surgical method is causing great interest. Data on the use of laser trabeculoplasty in surgical practice can be seen in the 1995-1996 work by Mark A. Latina and co-authors. Staff of the Samara Oblast Ophthalmological Hospital of the Russian Federation A.I.O. Turutina, A.S. Malyshev, An.O. Turutina, A.V. The benefits of laser trabeculoplasty have been identified as a result of 36 months of research conducted by the Fadeevas. A.I.O. Turutina, A.S. Malyshev, An.O. Turutina, A.V. According to Fadeeva's 36-month follow-up, it was found that laser trabeculoplasty surgery is considered the most effective method in patients with I-II stages of glaucoma (53.3% and 41.1% respectively). In these groups, the use of IOP-lowering eye drops has been reduced or stopped altogether. In stage III of primary open-angle glaucoma, if it is not possible to prescribe surgical treatment to the patient, laser trabeculoplasty can be used as an auxiliary method. It should also be mentioned that during the long follow-up period, the IOP in some patients decreased from the initial value to an average of  $6 \pm 1.3$  mm Hg. This condition is not sufficient to achieve the target pressure in stage III of glaucoma.

There were no statistically significant cases of sudden changes in vision in stages I, II and III of the disease ( $p > 0.05$ ). Figure 2 clearly shows the dynamics of visual acuity at various stages. The results represent the arithmetic mean values, the probable error means that the obtained results are reliable in 95% of cases.

Analyzing the results of optical coherence tomography for 12 months after laser trabeculoplasty performed for the purpose of treatment, no negative dynamic results were detected. It was found to be reliable ( $p > 0.05$ ) in patients with open-angle glaucoma in the I and II stages. Half a year after the first laser surgery, there were 2 patients in the III stage of the disease who underwent a repeat surgery and later achieved the desired IOP. remained stable in the postoperative period after laser trabeculoplasty, no statistically significant difference ( $p > 0.05$ ) was detected between the preoperative and postoperative values.

Thus, for all stages after laser trabeculoplasty, a statistically significant decrease in intraocular pressure was observed ( $p < 0.05$ ). In stages I and II, a stable level of KIB is observed, which does not exceed the target pressure value. 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. Differences in KIB levels 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 ( $p < 0.05$ ). When analyzing visual acuity parameters within 12 months after laser trabeculoplasty, negative dynamics were not detected in all patients with stages I and II of OBG, and statistically significant differences were not revealed in patients with stage III of the disease ( $p > 0.05$ ).

Thus, during the study, the maximum clinical effect (recovery of visual functions, improvement of tonographic parameters and OCT, achievement of the target IBD) was achieved after laser trabeculoplasty surgery.

#### Summary:

1. 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 the laser trabeculoplasty surgery, 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 laser trabeculoplasty for all stages, a statistically significant decrease in IOP was observed against the background of drug treatment. In stages I and II, the IOP level did not exceed the tolerable pressure value ( $p < 0.05$ ), and no significant changes in visual acuity were detected ( $p > 0.05$ ).

2. The dynamics of antihypertensive cancellation after laser trabeculoplasty 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 significantly increased, and stages I and II In some patients with open-angle glaucoma, it was possible not to take antihypertensive drugs at all ( $p < 0.001$ ).

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### **КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ЛАЗЕРНОЙ ТРАБЕКУЛОПЛАСТИЧЕСКОЙ ХИРУРГИИ ПРИ ГЛАУКОМЕ**

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**Резюме.** Противопоказания к препаратам разных фармакологических групп не повторяются в разных группах, что позволяет осуществлять подбор лечебных мероприятий в зависимости от сопутствующих заболеваний у конкретного пациента. У пациентов с первичной открытоугольной глаукомой лазерная трабекулопластика является методом, обеспечивающим значительно более высокий уровень эффективности снижения внутриглазного давления после операции на глазах с более тонкой роговицей. Единственным фактором, указывающим на эффективность лазерной трабекулопластики, является исходно высокий уровень внутриглазного давления.

**Ключевые слова:** глаукома, лазерная трабекулопластика.