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THE USE OF PHACOEMULSIFICATION WITH FEMTOSUPPORT IN CATARACTS WITH GLAUCOMA

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ABSTRACT

The problem of surgical treatment of cataracts in patients with concomitant glaucoma has been attracting the attention of ophthalmologists for many years. The work aimed to evaluate the effectiveness and safety of phacoemulsification with femtosupport in combination with glaucoma and cataract in combination with non-penetrating deep sclerectomy. The groups of patients differed according to the method of surgical intervention: phacoemulsification (271 eyes, 214 patients), phacoemulsification with femtosupport (461 eyes, 320 patients), phacoemulsification with non-penetrating deep sclerectomy with Xenoplast drainage implantation (14 eyes, 10 patients), phacoemulsification with non-penetrating deep sclerectomy with Xenoplast drainage implantation with femto-accompaniment (54 eyes, 43 patients). Visual acuity before surgery in the 1st group averaged 0.13, in the 2nd group 0.23, in the 3rd - 0.24, in the 4th - 0.14; 1 month after the operation 0.67, 0.72, 0.66, 0.68, respectively. In every instance, femtolaser support enabled the surgeon to speed up intraocular work. In none of the cases with a combination operation, there were any intraoperative hemorrhagic problems. It has been established that combined phacoemulsification and non-penetrating deep sclerectomy with Xenoplast implantation is an effective, safe intervention for the treatment of cataract and glaucoma patients on an outpatient basis. Femtosupport of phacoemulsification allows to reduce the time of intraocular work of the surgeon and does not lead to an increase in the number of surgical and postoperative complications.

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Introduction

The problem of surgical treatment of cataracts in patients with concomitant glaucoma has been attracting the attention of ophthalmologists for many years. Most of them prefer simultaneous combined interventions [1]. This approach is attractive because it allows you to simultaneously normalize intraocular pressure and increase visual acuity [2].

The combined method is more difficult, though. The likelihood of successful cataract surgery is lower in eyes with concurrent glaucoma [3]. The incompatibility between the requirement for tools to function in the pupil area with the inevitable mechanical action on the lens capsule and ligamentous apparatus and the actual status of these structures in glaucoma determines the challenges of cataract surgery on glaucoma eyes [4]. As for the choice of the antiglaucomatous component of the combined intervention, the technology of non-penetrating deep sclerectomy has huge advantages. It gives a minimal number of complications and is maximally adapted to combined use with phacoemulsification [5, 6]. The development of

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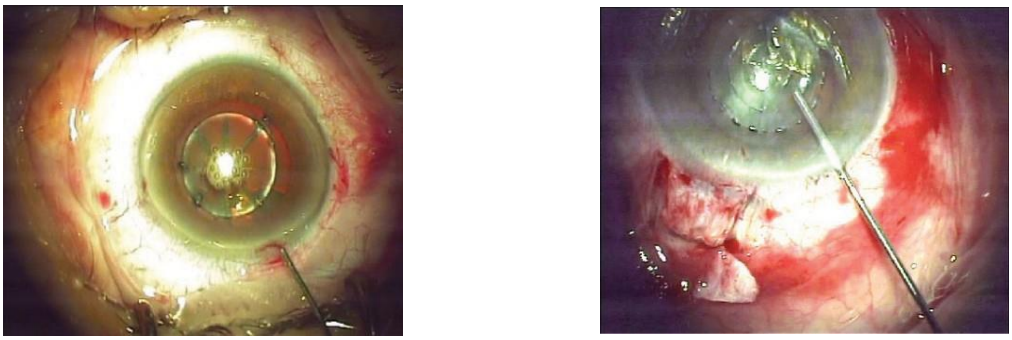
technical support for phacoemulsification led to the emergence of the so-called femtosupport of phacoemulsification [7]. The first experience in this field allowed us to assess in practice the increase in the atraumatic nature of phacoemulsification during the implementation of preliminary femtocapsulorexis and femtofragmentation of the cataract nucleus [8]. Since reducing the mechanical load on the capsule and ligamentous apparatus is most relevant for glaucoma eyes, in which dystrophic changes in the iris-lens diaphragm are more often observed [9], we tried to evaluate the effectiveness of phacoemulsification with femtosupport in glaucoma eyes. The question of the effect of phacoemulsification on postoperative intraocular pressure has been sufficiently studied [10], but we have not found information about the effect of phacoemulsification with femtosupport on intraocular pressure in the postoperative period and, in particular, in glaucoma patients.

The work aimed to evaluate the efficacy and safety of phacoemulsification with femtosupport in glaucoma eyes in combination with non-penetrating deep sclerectomy.

Materials and Methods

721 patients (794 eyes) aged from 44 to 86 years were operated on and examined, of which 54% were women and 46% were men. Groups were formed from them, operated by the following methods:

1. phacoemulsification (271 eyes);
2. phacoemulsification with femtosupport (461 eyes) **(Figure 1a)**;
3. phacoemulsification with non-penetrating deep sclerectomy and xenoplast drainage implantation (14 eyes);
4. phacoemulsification with non-penetrating deep sclerectomy with xenoplast drainage implantation with femtosupport (54 eyes) **(Figure 1b)**.



a) b)

Figure 1. Methods of operation during the experiment: femtoetap with phacoemulsification with femtosupport (a), femtosupport with non-penetrating deep sclerectomy combined with phacoemulsification with femtosupport (b)

At the same time, the study was of the nature of a continuous perspective since the results of all operations performed during the study period, which began from the moment the femtolaser was put into operation, were analyzed. Not a single patient was removed from the studied groups.

The comparison groups were also formed with a continuous study, but it was retrospective with a depth of up to 4 months for Group 1 and 1 month for Group 3. Before and after surgery, patients underwent routine ophthalmological examinations in order to plan the operation and accurately calculate intraocular lenses to achieve the required individual target refraction. In addition, during the diagnosis, the level of preoperative intraocular pressure and the stage of glaucoma were established.

Additionally, optical coherence tomography of the retina was performed, a study on the ORA apparatus (Reichert, USA), and Pg was determined. Intraoperative measurement of intraocular pressure was performed using a manual Tonopen Aero tonometer (Reichert, USA) **(Figure 2)**.

Figure 2. Measurement of intraocular pressure after applying a vacuum ring for femtosupport

According to the recommendation of the European Society of Cataract and Refractive Surgeons, 0.5% levofloxacin 1 drop 4 r/d, nevanac 3p/ d; mydriatic tropicamide 1% was prescribed to all patients 2 days before surgery. If it was impossible to achieve mydriasis for femtocapsulorexis (less than 5 mm), phacoemulsification was planned for such patients without femtosupport.

Phacoemulsification was performed using a Stellaris-PC phacoemulsifier (Bausch & Lomb, USA). Femtolaser support was performed at the Victus installation (Technolase Perfect Vision, Germany). The noted differences in the groups are associated with slower achievement of mydriasis in patients with glaucoma. In the fragmentation of the lens nucleus in glaucoma patients, only radial patterns of fragmentation of the nucleus into 8 parts were used.

The characteristics of the femtolaser tracking parameters are shown in **Table 1**.

The following types of intraocular lenses were used for intraocular correction: Acrisof (Alcon, USA), En Vista (Bausch & Lomb, USA), Acrystyle (Transcontact, Russia), and Hoya (Japan). In this way, approximately the same number of hydrophilic and hydrophobic intraocular lenses were implanted **(Table 2)**.

Non-penetrating deep sclerectomy with implantation of Xenoplast collagen drainage was used as an anti-glaucomatous component (Transcontact, Russia).

All operations were performed on an outpatient basis. 1 hour after the operation, the patients were sent home. The examinations were carried out on the 1st, 3rd, 7th, and 14th day, 1 month after the operation.

Postoperative management was standard: combined steroid drugs in combination with antibiotics (2-3 weeks) and nonsteroidal anti-inflammatory drugs 4 times a day (4 weeks), hypotensive, Okvis 0.3% as an eye tissue protector up to 1-2 months after surgery.

In the postoperative period, instrumental examination of patients was also performed, which included monitoring of intraocular pressure, according to Goldman (Rd).

Mathematical processing was carried out by methods of variational statistics.

Results and Discussion

The imposition of a vacuum ring before the femtocapsulorexis procedure and fragmentation of the nucleus led, in some cases, to an increase in intraocular pressure. The average intraocular pressure at this stage of the operation was 35.5±8.1 mmHg. Generally speaking, cases of a considerable rise in intraocular pressure were linked to patients' restless behaviour and excessive compression of their eyelids, and they had no adverse effects. No new pathological changes to the retina or optic nerve were found in the postoperative term, according to the optical coherence tomography of the retina. The results of measuring corrected visual acuity before and after surgery in all 4 groups are presented in **Table 3**. Before surgery, no statistically significant differences were found between the first and second groups. There were also no statistically significant differences between the third and fourth groups, which may additionally indicate the correct compilation of the presented comparison groups. On the first day after surgery, there was no statistically significant difference in data in all four groups. Intraocular pressure levels in the first two groups on the first day after surgery were almost identical, i.e., the addition of the feet stage to the standard phacoemulsification procedure did not affect the level of intraocular pressure in the early postoperative period. In most cases of combined glaucoma and cataract surgery, comparable levels of intraocular pressure were obtained, which indicates the neutrality of the femtostage in relation to an increase in the risk of postoperative hypertension in glaucoma patients as well. At the same time, as a result of comparing the levels of intraocular pressure before surgery and on the first day after the interventions, a strong direct correlation between the postoperative figures and the level of preoperative intraocular pressure was revealed in all 44 patients **(Table 4)**. Two cases fell out of the general pattern when pronounced external filtration of intraocular fluid was observed on the first day after surgery.

Table 1. Femtosecond laser settings

Patient groups	Capsulorexis D (mm)	Capsulorexis Energy (nJ)	Core Fragmentation Energy (nJ)	Number of Radial patterns
Phacoemulsification	5			
Phacoemulsification with femtosupport	4.7 - 5.2	5000	8000	6 - 8
Phacoemulsification with femtosupport with non-penetrating deep sclerectomy	4.7 - 5.0	5000 - 5200	8000	8

Table 2. Distribution of types of implanted intraocular lenses

Patient groups	Acristyle	Acrysof IQ	En - Vista	Hoya
Phacoemulsification	113	119	37	0
Phacoemulsification with femtosupport	143	205	105	8
Phacoemulsification with non-penetrating deep sclerectomy	5	6	0	0
Phacoemulsification with femtosupport with non-penetrating deep sclerectomy	10	29	14	0

Table 3. Corrected visual acuity

Patient groups	Before the operation	After 1 Month
Phacoemulsification (n=269)	0.13±0.02	0.67±0.18
Phacoemulsification with femtosupport (n=461)	0.23±0.02	0.72±1.6
Phacoemulsification with non-penetrating deep sclerectomy (n=11)	0.24±0.05	0.66±0.17
Phacoemulsification with femtosupport with non-penetrating deep sclerectomy (n=53)	0.14±0.03	0.68±0.13

Table 4. Intraocular pressure in observation groups

Patient groups	Before the operation	After 1 Day	After 1 Month
Phacoemulsification (n=269)	16.5±1.8	22.3±4.0	14.9±1.9
Phacoemulsification with femtosupport (n=461)	16.9±2.1	21.9±4.1	18.1±1.6
Phacoemulsification with non-penetrating deep sclerectomy (n=11)	30.0±5.1	29.8±6.0	19.4±2.0
Phacoemulsification with femtosupport with non-penetrating deep sclerectomy (n=53)	35.4±7.0	24.8±5.1	16.4±3.2

In the group of combined interventions, there were no dislocations of the nucleus or fragments of the nucleus, all patients managed to preserve the capsule sac and implant an intraocular lens into the capsule sac. In 5 cases, a capsule ring was implanted into the capsule bag, which was planned before the operation. Femtolaser support in all cases helped the surgeon to reduce the time of intraocular work. So the time of the combined intervention without femtosupport ranged from 24 to 35 minutes, and after the femtosupport it was reduced to 16-22 minutes. There were no intraoperative hemorrhagic complications in any case of combined intervention. There was no difference in the number of patients with corneal edema on the first day after surgery. Corneal epithelial edema was associated with postoperative hypertension. In the group of combined interventions, intraocular pressure was normalized 5-10 days after surgery. At an intraocular pressure level of 17-20 mmHg, patients were prescribed constant instillations of antihypertensive drugs (with intraocular pressure monitoring every 3 months and visual functions once every 6 months).

Conclusion

Phacoemulsification combined with non-penetrating deep sclerectomy with Xenoplast implantation is an effective, safe intervention for the treatment of cataract and glaucoma patients on an outpatient basis. Femtosupport phacoemulsification (rexis and fragmentation) reduces the time of intraocular surgery and is a safe intervention in patients with a combination of cataracts and open-angle glaucoma. In combination with non-penetrating deep sclerectomy with implantation of Xenoplast collagen drainage, phacoemulsification with femtosupport does not lead to an increase in the number of surgical and postoperative complications. The level of intraocular pressure in the early period after femtosupport phacoemulsification in patients who underwent this operation in combination with non-penetrating deep sclerectomy with implantation of collagen drainage Xenoplast does not differ from the level of intraocular pressure in patients after conventional interventions.

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Ethics statement: All patients signed an agreement for volunteer participation in the experiment.

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