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Research article



Influence of the quality of viscoelastic removal on phacoemulsification results. Part 2. Dependence of “IOL – posterior lens capsule” interface status on viscoelastic visualization

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BACKGROUND: Main methods of intraoperative secondary cataract prevention are measures aimed at the formation of full contact of the intraocular lens (IOL) with the posterior capsule. The diastasis between the IOL and the posterior capsule is explained by the presence of viscoelastic in the interface. Maximum visualization of the stained viscoelastic will obviously make it possible to completely remove it from the eye, which will increase the number of eyes with the optimal “IOL – posterior capsule” interface with standard phacoemulsification.

AIM: The aim was to study “IOL – posterior capsule” interface status after phacoemulsification of senile cataract in relation to viscoelastic visualization.

MATERIALS AND METHODS: 122 eyes of 122 patients were included, which underwent phacoemulsification of senile cataract with femto-laser assistance and were divided into 2 groups depending on viscoelastic characteristic (colored or transparent) used for anterior chamber filling prior to IOL implantation. “IOL – posterior capsule” interface status was examined on the 1st and 7th day post-op in order to evaluate the contact between two structures.

RESULTS: On the 1st day post-op, the absence of contact between IOL and posterior capsule was noticed more often in the second group, the number of eyes with this type of interface was 1.5 times lower in the 1st group. On the 7th day after surgery, optimal interface had place in 9 out of 10 eyes in the 1st group, in comparison with 2/3 of patients from the second group.

CONCLUSION: Conducted investigation showed that the use of colored viscoelastic allowed creating the optimal “IOL – posterior capsule” interface on the 7th day post-op in 87% of eyes of the main group in comparison with 67% eyes from the control group (the difference is statistically significant). The absence of contact between IOL and capsule can be considered as relative capsule block, which may form the high risk of secondary cataract.

Keywords: phacoemulsification; viscoelastic; posterior lens capsule; “IOL – posterior capsule” interface.

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Научная статья

Влияние качества удаления вискоэластика на результаты факоемульсификации.

Часть 2. Зависимость состояния интерфейса «интраокулярная линза – задняя капсула хрусталика» от визуализации вискоэластика

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Актуальность. Основными методами интраоперационной профилактики вторичной катаракты являются мероприятия, направленные на формирование полного контакта интраокулярной линзы (ИОЛ) с задней капсулой хрусталика (ЗКХ). Диастаз между интраокулярной линзой с задней капсулой хрусталика объясняется наличием вискоэластика в интерфейсе. Максимальная визуализация окрашенного вискоэластика, очевидно, позволит полностью удалить его из глаза, что увеличит количество глаз с оптимальным интерфейсом «ИОЛ – ЗКХ» при стандартной факоемульсификации.

Цель — исследовать зависимость состояния интерфейса «ИОЛ – ЗКХ» после факоемульсификации возрастной катаракты от визуализации вискоэластика.

Материалы и методы. Исследованы 122 глаза (122 пациента), оперированных по поводу возрастной катаракты методом факоемульсификации с фемтосекундным лазерным сопровождением и разделённых на 2 группы в зависимости от характеристики вискоэластика (окрашенный или неокрашенный), используемого для заполнения передней камеры перед имплантацией интраокулярной линзы. В первые сутки и на 7-й день после факоемульсификации исследовали интерфейс «ИОЛ – ЗКХ» с целью оценки контакта интраокулярной линзы с капсулой.

Результаты. В первые сутки после операции отсутствие контакта интраокулярной линзы с задней капсулой хрусталика наблюдали чаще во второй группе, количество глаз с этим типом интерфейса в первой группе было в 1,5 раза меньше. Через 7 дней после операции оптимальный интерфейс «ИОЛ – ЗКХ» имел место в 9 из 10 глаз первой группы, в то время как у пациентов второй группы — в 2/3 случаев.

Заключение. Проведённое исследование показало, что применение окрашенного вискоэластика позволило обеспечить на 7-е сутки после операции оптимальный интерфейс «ИОЛ – ЗКХ» в 87 % глаз основной против 67 % глаз контрольной группы (отличие статистически значимо). Отсутствие контакта интраокулярной линзы с капсулой можно рассматривать как относительный капсульный блок, наличие которого может формировать высокий риск вторичной катаракты.

Ключевые слова: факоемульсификация; вискоэластик; задняя капсула хрусталика; интерфейс «интраокулярная линза – задняя капсула хрусталика».

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BACKGROUND

The main task of phacoemulsification (PE) is the creation of an optimal course of light rays in the operated eye by providing maximum transparency of the optical media [1, 2]. However, the secondary cataract that develops after surgery, leading to optical deprivation and reduced visual acuity, is recognized as the most common complication of PE of age-related cataract and is registered with a frequency of 1%–56% at various times [3–7]. The main methods of intraoperative prophylaxis include measures aimed at preventing the migration of lens epithelial cells from the equatorial zone to the center owing to the full contact of the intraocular lens (IOL) with the posterior lens capsule (PC) [8–10].

However, previous studies have revealed that the optimal IOL–PC interface in the form of their full contact is noted in up to 41.5% of operated eyes on day 1 after surgery [3, 8]. The presence of the viscoelastic (VE) substance in the interface, which determines the diastasis size, was one of the causes of diastasis between the IOL and PC, thereby increasing the risk of a regenerative secondary cataract [11–13].

Residual VE in the lens capsule is prevented by impulse irrigation, which is used to increase by 1.8 times the number of eyes with IOL that fully contacted with the PC, compared with the standard method of removing VE using the irrigation–aspiration system [8, 9]. Moreover, this technique does not allow full contact of the IOL with the PC in all eyes where it was used, apparently due to the poor visualization of the removed VE, which leads to its incomplete evacuation [3]. The use of the stained VE in combination with pulse irrigation proposed by F. Polit and A. Polit (2016) can possibly increase the number of eyes with the optimal IOL–PC interface [14, 15]. Undoubtedly, to confirm the above assumption, appropriate clinical studies are necessary, and based on their results, the conclusion can be drawn for the optimal method or combination of methods for removing VE in PE.

The work aimed to investigate the dependence of the state of the IOL–PC interface after PE of age-related cataract on the visualization of VE.

MATERIALS AND METHODS

A total of 122 eyes of 122 patients who underwent surgery for age-related cataracts (presenile and senile according to International Classification of Diseases 10th edition) were under follow-up. Patients whose conditions were optimal for surgery were enrolled in the study group, such as the presence of mydriasis of at least 6 mm, density of the lens nucleus of NC2–3 according to the LOCS III classification (1993) [16], absence of

exfoliation or signs of weakness of the lens zonular support, corneal pathology, and severe somatic pathology. The study included 58 men and 64 women aged 62–81 (average 74.5 ± 6.5) years.

All patients underwent PE according to the standard procedure, and to unify its parameters, capsulorhexis with a diameter of 5.0 mm was performed using a LensX femtosecond laser (Alcon, TX, USA), fragmentation of the lens nucleus was conducted, and the main corneal incision (2.2 mm) was made at the 10 o'clock position, along with two additional corneal incisions (1.1 mm each) at the 1 and 7 o'clock positions. Then, the lens nucleus was fragmented and removed using the Infinity phacoemulsifier (Alcon) through the phaco-chop technique, the cortical masses were aspirated using a bimanual irrigation–aspiration system, and the Hoya Iserit IOL (Japan) was implanted.

In all cases, at the removal of the anterior capsule central fragment formed after femtocapsulorhexis, VE DisCoVisc (Alcon) was administered. Depending on the characteristics of the VE used to fill the anterior chamber before IOL implantation, all eyes were distributed into two groups. In 62 eyes of group 1 (main), stained VE was used, which was obtained by mixing 0.55 mL of Provisc VE (Alcon) with 0.1 mL of Rhex ID Trypan Blue solution (Appasamy, India) by several movements of the syringe plunger back and forth according to the method proposed by F. Polit and A. Polit [14]. The stained VE was injected into the anterior chamber and capsular bag. Group 2 (control) consisted of 60 patients (60 eyes) whose anterior chamber was filled with Provisc VE (Alcon) before IOL implantation. In all cases, when removing the VE, the pulse irrigation method was used [9].

After surgery, all patients received treatment with instillations of 0.3% ciprofloxacin solution four times a day for 7 days and 0.1% dexamethasone solution three times a day for 1 month.

In all cases, before surgery, a standard ophthalmological examination was performed, including visometry, biometry, ophthalmometry, refractometry, biomicroscopy, and ophthalmoscopy.

In all eyes, on day 1 and day 7 after PE, the IOL–PC interface was examined on the RS3000 Advance device (Nidek, Japan) to assess the IOL contact with the capsule (Figs. 1–3).

The study did not include patients with glaucoma, severe somatic pathology, and a history of allergic reactions.

Statistical data processing was performed using the IBM SPSS Statistics version 20. Qualitative features were compared using Fisher's exact two-tailed test. Differences were considered significant at 0.05.

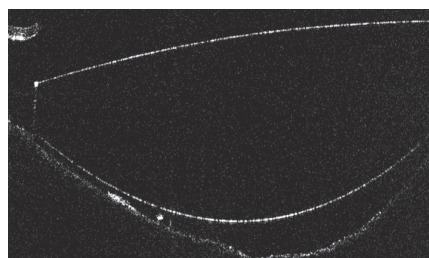


Fig. 1. Absence of contact between IOL and posterior lens capsule

Рис. 1. Отсутствие контакта интраокулярной линзы с задней капсулой хрусталика

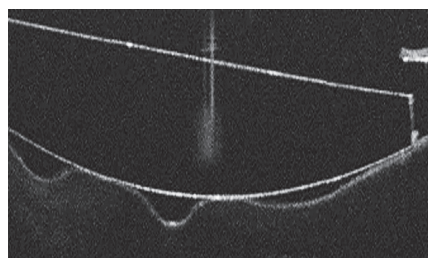


Fig. 2. Incomplete contact between IOL and posterior lens capsule

Рис. 2. Частичный контакт интраокулярной линзы с задней капсулой хрусталика

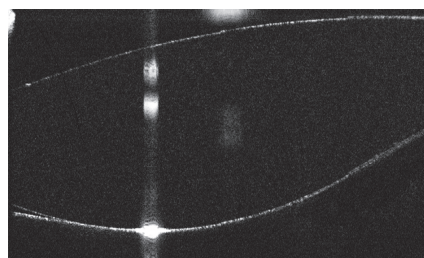


Fig. 3. Full contact between IOL and posterior lens capsule

Рис. 3. Полный контакт интраокулярной линзы с задней капсулой хрусталика

RESULTS

All procedures were performed according to the schedule. No intraoperative complications were noted in any case, and the postoperative period was nonresponsive.

The data analysis (Table 1) revealed that on day 1 after surgery, the IOL contact with the PC was more often absent in group 2, and the number of eyes with this type of interface in group 1 was 1.5 times less.

The following changes in all studied parameters were registered 7 days after surgery. The number of eyes with full IOL contact with PC increased 1.8 times in group 1 and 2.3 times in group 2. During this follow-up period, the optimal IOL–PC interface was noted in 9 of 10 eyes in group 1 and in 2 of 3 in group 2. During optical coherence tomography, the presence of VE between the lens and the capsule was not determined in any case.

DISCUSSION

Currently, no methods can ensure the IOL full contact with the PC [17–19]. A standard PE that does not require additional technical methods and (or) improved consumables will not enable to achieve the above goal.

Table. “IOL – posterior capsule” interface status at different timepoints after phacoemulsification of senile cataract, absolute value (%)

Таблица. Состояние интерфейса «интраокулярная линза – задняя капсула хрусталика» в различные сроки после факоэмульсификации возрастной катаракты, абс. (%)

Group	“IOL–posterior capsule” full contact	
	Day 1	Day 7
Group 1 (n = 62)	30 (48)	54 (87)
Group 2 (n = 60)	17 (28)*	40 (67)*

* Significant differences in group 1 ($p < 0.05$).

IOL pneumocompression can be recognized as one of the methods that improve this condition; however, its use is possible only in eyes with sufficient mydriasis and complete preservation of Zinn’s zonule [8]. Moreover, in the literature, no effective methods can provide the required result in the absence of optimal conditions for PE of age-related cataract.

The results of this study show the efficiency of the stained VE, as the optimal IOL–PC interface in the final follow-up period occurred nearly 1.5 times more often than when using the standard VE. Despite the presence of the reflex from the fundus, in any VE contrasts, when “blurring” with an irrigation solution, the detailing of its residues can be difficult, whereas the stained VE was determined in the pupil plane in all cases.

In our opinion, the absence of contact between the lens and the capsule on day 1 after surgery cannot be considered the final state of the interface because the primary contraction of the lens capsule at this point may not be fully completed, and at 7 days after PE, the IOL diastasis from the capsule is caused by VE. A relatively small number of eyes in both groups (6 eyes, 8%) had VE in the interface, which was determined by optical coherence tomography on day 1 after surgery, because of its hydration and a decrease in optical density, making visualization difficult. Moreover, the absence of IOL contact with PC 7 days after PE is due to the difficulty of spontaneous VE release from the capsule because of the tight contact of the lens with the opening of the anterior capsulorhexis, just as in the case of capsular block [11]. Presumably, the absence of IOL contact with the lens capsule in the eight eyes of the main group was due to the incomplete removal of the VE between the optical and haptic elements of the IOL, its subsequent hydration, and migration to the central zone.

CONCLUSIONS

1. The study showed that the use of stained VE helped provide the optimal IOL–PC interface on day 7 after

surgery in 87% of the eyes of the main group compared with 67% of the eyes of the control group, which showed significant difference.

2. The lack of the IOL contact with the capsule can be considered a relative capsular block that can bear a high risk of secondary cataract.

3. Assessing the state of the IOL–PC interface on day 1 after surgery was not recommended because of its high variability in the future.

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ADDITIONAL INFORMATION

Author contributions. All authors confirm that their authorship complies with the ICMJE criteria. They all have made a significant contribution to the development of the concept, research, and preparation of the article, read and approved the final version before its publication.

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