



## INVESTIGATION OF TEAR PRODUCTION DYNAMICS IN PATIENTS WITH AGE-RELATED CATARACT BEFORE AND AFTER PHACOEMULSIFICATION

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✧ **Purpose.** To investigate the tear production (TP) dynamics in patients with age-related cataract before and after phacoemulsification (PE). **Material and methods.** 136 patients (136 eyes) admitted for age-related cataract treatment. Age —  $69.3 \pm 6.4$  years. 64 men and 72 women. Besides standard ophthalmological examination, in all patients Schirmer's I test was performed before surgery on the next day, 7, 14 and 30 days after surgery. Patients were divided into 4 groups. The 1st group consisted of 32 patients (32 eyes) with TP 15 mm and more. The 2nd group — 48 patients (48 eyes) with TP from 10 to 15 mm. The 3rd group — 40 patients (40 eyes) with TP from 5 to 10 mm. The 4th group — 16 patients (16 eyes) with TP less than 5 mm. In all patients, PE was performed according to standard technology. **Results.** All surgeries were performed without complications. In 56 eyes of groups 3 and 4 (41.2%), there was a depression of TP of moderate and severe degree before surgery. The first day after surgery in all study groups there was twofold increase of Schirmer's test indices. Starting from 7th day after surgery, in all groups, a 22-35% decrease of TP from baseline was observed. Later on, a gradual increase of TP was noted. On the 30th day after PE, Schirmer's test indices were lower than those of baseline in 4 eyes (13%) of the 1st group, 10 eyes (21%) of the 2nd group, 31 eyes (77%) of the 3rd group, and 10 eyes (63%) of the 4th study group. **Conclusions.** The study of TP in patients with age-related cataract showed that during one month after surgery TP returned to baseline indices only in 59.6% of patients. Regardless of its baseline indices, after the surgery, there is an universal TP dynamics, which is characterized by its initial increase, subsequent decrease and gradual return to baseline indices. Patients with initial low TP indices have potentially high risk of developing clinically significant dry eye syndrome.

✧ **Keywords:** age-related cataract; tear production; dry eye syndrome; phacoemulsification.

## ИССЛЕДОВАНИЕ ДИНАМИКИ СЛЕЗОПРОДУКЦИИ У БОЛЬНЫХ С ВОЗРАСТНОЙ КАТАРАКТОЙ ДО И ПОСЛЕ ПРОВЕДЕНИЯ ФАКОЭМУЛЬСИФИКАЦИИ

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✧ **Цель.** Исследовать динамику слезопродукции (СП) у больных с возрастной катарактой до и после проведения факоемульсификации (ФЭ). **Материал и методы.** 136 пациентов (136 глаз), обратившихся для оперативного лечения возрастной катаракты. Возраст —  $69,3 \pm 6,4$  года. 64 мужчины и 72 женщины. Кроме стандартного офтальмологического обследования, всем больным перед операцией и на следующий день, через 7, 14 и 30 суток после операции проводили тест Ширмера I. Пациенты были распределены на четыре группы. Первая группа — 32 больных (32 глаза) с СП 15 мм и более. Вторая группа — 48 пациентов (48 глаз) с СП от 10 до 15 мм. Третья группа — 40 больных (40 глаз) с СП от

5 до 10 мм. Четвёртая группа — 16 пациентов (16 глаз) с СП менее 5 мм. Всем пациентам ФЭ проведена по стандартной методике. **Результаты.** Операции были выполнены без осложнений. В 56 глазах 3-й и 4-й групп (41,2 %) перед операцией имели место умеренная и тяжёлая степень угнетения СП. В первые сутки после операции во всех исследуемых группах произошло двукратное увеличение показателей пробы Ширмера. Начиная с 7-го дня после операции во всех группах отмечалось уменьшение СП на 22–35 % относительно исходного значения. Затем отмечался постепенный рост СП: к 30-мудню после ФЭ показатели проб Ширмера были ниже исходных в 4 глазах (13 %) первой группы, 10 глазах (21 %) второй группы, 31 глазу (77 %) третьей и 10 глазах (63 %) четвёртой групп исследования. **Заключение.** Проведённое исследование СП у пациентов с возрастной катарактой показало, что в течение месяца после операции СП восстанавливается до исходных значений только у 59,6 % пациентов. Независимо от её исходного уровня после операции происходит универсальная динамика СП, которая характеризуется первоначальным её повышением, последующим снижением и постепенным возвращением к исходным значениям. У пациентов с исходно низким уровнем СП при хирургии возрастной катаракты имеется потенциально высокий риск развития клинически выраженного ССГ.

✧ **Ключевые слова:** возрастная катаракта; слезопродукция; синдром «сухого глаза»; факоэмульсификация.

## INTRODUCTION

The prevention and treatment of dry eye syndrome (DES) after eye surgery present a significant challenge for ophthalmologists. Among patients who have undergone surgery on the anterior segment of the eye, the prevalence of DES varies between 3.6% and 16% [1–6]. DES substantially reduces the quality of medical and social rehabilitation in such patients. The most frequently utilized surgical ophthalmic procedure is cataract surgery, with an estimated 20 million procedures being performed annually worldwide [7]. The major risk factors for DES after phacoemulsification (PE) include damage to the corneal and conjunctival epithelia, damage to corneal nerve fibers resulting in impaired tear production (TP) at the level of the cornea–trigeminal nerve–lacrimal gland, corneal asphericity, and the long-term application of antibacterial and anti-inflammatory eye drops after surgery [7–15]. Elderly patients with cataract often have several risk factors for reduced TP or impaired tear film stability (including concomitant somatic diseases and the systemic use of drugs), which cause combined forms of DES [16, 17]. Thus, several patients develop or experience an exacerbation of DES after PE, which reduces the functional impact of the surgery [8, 18, 19]. Therefore, for preventing DES, patients with age-related cataract (ARC) require a detailed examination of TP at all stages of treatment.

The aim of this study was to assess the dynamics of TP in patients with ARC after PE.

## MATERIALS AND METHODS

The present study included 136 patients (136 eyes) aged between 62 and 83 years (mean age,  $69.3 \pm 6.4$  years) who underwent surgical treatment

for ARC. The cohort comprised 64 males and 72 females. The main inclusion criteria included initial or immature ARC and sufficient mydriasis that was considered optimal for surgery.

In addition to the standard ophthalmologic examination (refractometry, ophthalmometry, biometry, ophthalmoscopy, and tonometry), all patients underwent Schirmer I test prior to surgery and then at 1, 7, 14, and 30 days post-surgery using commercially available test strips (Bausch & Lomb, USA). TP was measured according to the following standard method: the end of a test strip was bent at  $45^\circ$  and placed behind the lower eyelid in the lateral third of the eye fissure (without touching the cornea). After 5 min, the test strip was removed, and the length of tear absorption on the strip was measured for the assessment of TP.

After examination, all patients were divided into four groups depending on the level of TP (according to the classification developed by E.E. Somov and V.V. Brzhesky) [1]. Group 1 included 32 patients (32 eyes) with a strip wetting length of  $\geq 15$  mm (normal TP); group 2 included 48 patients (48 eyes) with wetting lengths between 10 and 15 mm; group 3 included 40 patients (40 eyes) with wetting lengths between 5 and 10 mm (moderate suppression of TP); and group 4 included 16 patients (16 eyes) with a wetting length of  $< 5$  mm (severe suppression of TP).

Patients with pronounced symptoms of DES, infectious diseases of the anterior segment of the eye, or glaucoma were excluded from the analysis.

All patients underwent PE according to the standard phaco-chop technique using the Infiniti phacoemulsification system (Alcon, USA), and were implanted with various acrylic intraocular lenses (IOLs).

Table 1

Tear production indices in patients with age-related cataract before and various time points after phacoemulsification, absolute values ( $M \pm m$ )

Таблица 1

Показатели слезопродукции у пациентов с возрастной катарактой перед и в различные сроки после факэмульсификации, абс. ( $M \pm m$ )

Group, number of eyes	Schirmer I test (mm)				
	Before surgery	Time point			
		Day 1	Day 7	Day 14	Day 30
Group 1, 32 eyes (24%)	15–17 ( $15.8 \pm 1.2$ )	25–27 ( $25.5 \pm 1.4$ )	8–12 ( $10.4 \pm 2.8$ )	8–14 ( $12.6 \pm 2.9$ )	13–16 ( $14.2 \pm 1.8$ )
Group 2, 48 eyes (35%)	10–13 ( $11.1 \pm 1.7$ )	15–25 ( $19.7 \pm 3.5$ )	5–10 ( $7.3 \pm 3.1$ )	7–10 ( $8.1 \pm 1.8$ )	9–11 ( $9.8 \pm 1.4$ )
Group 3, 40 eyes (29%)	5–7 ( $5.9 \pm 2.1$ )	10–17 ( $12.2 \pm 3.3$ )	3–5 ( $3.8 \pm 1.3$ )	3–7 ( $4.1 \pm 2.2$ )	3–5 ( $3.7 \pm 1.7$ )
Group 4, 16 eyes (12%)	2–4 ( $3.2 \pm 0.6$ )	5–12 ( $6.6 \pm 2.7$ )	2–4 ( $2.4 \pm 0.7$ )	2–4 ( $2.3 \pm 0.7$ )	2–3 ( $2.4 \pm 0.5$ )

Post-surgically, all patients received drops of a 0.5% Signicef solution four times a day for 7 days and 0.1% dexamethasone in decreasing doses for a month, starting at four times a day.

## RESULTS AND DISCUSSION

None of the patients developed postoperative complications, and the postoperative period was uneventful.

The TPs of the patients with ARC at various time points after PE are shown in Table 1. We observed that 56 patients from groups 3 and 4 (41.2%) exhibited moderate-to-severe suppression of TP before surgery and, therefore, an increased risk of developing DES after PE.

During the first day after surgery, all patients demonstrated an almost twofold increase of TP in the Schirmer test, and this was probably induced by a direct intraoperative corneal injury.

Starting from day 7 after surgery, we observed a 22%–35% reduction in TP in all groups, followed by a gradual increase. However, none of the patients achieved their preoperative levels of TP. The most significant suppression of TP was observed in group 4.

By day 30 after PE, 31 patients from group 3 (77%) and 10 patients from group 4 (21%) maintained decreased TP compared with baseline values. Four patients from group 1 (13%) and 10 patients from group 2 (63%) also failed to reach their baseline TP, probably because of the long-term application of anti-inflammatory eye drops containing preservative agents.

## CONCLUSION

Our results suggest that only 60% of patients with ARC achieved their baseline TP within 1 month after PE. We observed similar dynamics of TP in all patients, regardless of their baseline TP rates; this included an initial increase in TP with subsequent

reduction, followed by a gradual restoration. Fifty-six patients with initially suppressed TP (41%; groups 3 and 4) had a high risk of DES after surgery.

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