

## CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME

© V.V. Potemkin<sup>1,2</sup>, E.V. Goltsman<sup>2</sup>

<sup>1</sup> Academician I.P. Pavlov First St. Petersburg State Medical University, Saint Petersburg, Russia;

<sup>2</sup> City Ophthalmologic Center of City Hospital No. 2, Saint Petersburg, Russia

*For citation:* Potemkin VV, Goltsman EV. Cataract surgery in pseudoexfoliation syndrome. *Ophthalmology Journal*. 2020;13(1):37-42. <https://doi.org/10.17816/OV25739>

Received: 15.01.2020

Revised: 03.03.2020

Accepted: 23.03.2020

✧ Phacoemulsification is a main method of cataract surgery. The presence of pseudoexfoliation syndrome (PEX) may involve the procedure in difficulty and contribute to development of intra- and postoperative complications. **Purpose.** To assess the effect of PEX on phacoemulsification. **Materials and methods.** 1010 patients (580 with PEX and 430 without PEX) admitted for cataract surgery, underwent phacoemulsification with implantation of various IOL types. An analysis of main phacoemulsification parameters was carried out: cumulative dissipated energy (CDE), aspirated BSS amount, time of surgery. The prevalence of some possible intraoperative complications was assessed: descemet membrane detachment, posterior capsule rupture, retrolental lens material, and zonular dialysis. **Results.** In patients with PEX, local descemet membrane detachment and retrolental lens material were significantly more common, at the same time CDE was higher. **Conclusion.** When planning phacoemulsification, patients with PEX require more thorough preoperative examination, higher alertness during surgery and longer follow-up in the postoperative period.

✧ **Keywords:** pseudoexfoliation syndrome; phacoemulsification; cataract.

## ХИРУРГИЯ КАТАРАКТЫ ПРИ ПСЕВДОЭКСФОЛИАТИВНОМ СИНДРОМЕ

© В.В. Потёмкин<sup>1,2</sup>, Е.В. Гольцман<sup>2</sup>

<sup>1</sup> Федеральное государственное бюджетное образовательное учреждение «Первый Санкт-Петербургский государственный медицинский университет им. академика И.П. Павлова» Министерства здравоохранения Российской Федерации, Санкт-Петербург;

<sup>2</sup> Санкт-Петербургское государственное бюджетное учреждение здравоохранения «Городская многопрофильная больница № 2», Санкт-Петербург

*Для цитирования:* Потёмкин В.В., Гольцман Е.В. Хирургия катаракты при псевдоэксфолиативном синдроме // Офтальмологические ведомости. — 2020. — Т. 13. — № 1. — С. 37–42. <https://doi.org/10.17816/OV25739>

Поступила: 15.01.2020

Одобрена: 03.03.2020

Принята: 23.03.2020

✧ Основным способом хирургического лечения катаракты является факоэмульсификация (ФЭ). Наличие псевдоэксфолиативного синдрома (ПЭС) может не только осложнять её выполнение, но и быть причиной множества осложнений, как интраоперационных, так и послеоперационных. **Цель.** Оценить влияние ПЭС на течение ФЭ. **Материалы и методы.** 1010 пациентам (580 с ПЭС и 430 без ПЭС), поступившим для хирургического лечения катаракты, была выполнена ФЭ с имплантацией различных видов интраокулярных линз. Проведен анализ основных параметров ФЭ: кумулятивной рассеянной энергии ультразвука, количества аспирированного сбалансированного солевого раствора (BSS), времени операции. Также выполнена оценка частоты встречаемости некоторых возможных интраоперационных осложнений: отслойки десцеметовой оболочки, разрыва задней капсулы, ретролентально расположенного хрусталикового вещества и зонулодиализа. **Результаты.** У пациентов с ПЭС достоверно чаще встречалась локальная отслойка десцеметовой оболочки, а также и ретролентально расположенное хрусталиковое вещество, при этом кумулятивная рассеянная энергия ультразвука была выше. **Выводы.** При планировании ФЭ пациенты с ПЭС требуют более тщательного предоперационного осмотра, большей настороженности во время операции и более длительного наблюдения в послеоперационном периоде.

✧ **Ключевые слова:** псевдоэксфолиативный синдром; факоэмульсификация; катаракта.

## INTRODUCTION

Cataracts are one of the primary causes of reversible blindness in the world [1]. Usually, cataracts develop because of the aging process; however, the presence of pseudoexfoliation syndrome (PEX) also induces sclerotic changes in the lens nucleus [2, 3]. Phacoemulsification (PE) is the primary method of surgical treatment for cataracts.

PEX, an age-related disease that affects many organs and systems, is based on the production and accumulation of fibrillar material in various tissues of the body. Most often, pseudoexfoliation material (PEM) appears on the anterior capsule of the lens, the pigment epithelium of the iris, the ciliary body, ciliary zonules, and the corneal endothelium [4–6]. It is reasonable to assume that PEM accumulations are caused by morphological changes in the anterior eye, which, in turn, can theoretically complicate the PE course, causing a variety of intra- and postoperative complications [5]. The most common intraoperative complications are ruptures of ciliary zonules and posterior capsule, and vitreous body prolapse. The most common postoperative complications include intraocular inflammation, opacification of the posterior lens capsule, phimosis of the anterior lens capsule, and various degrees of intraocular lens (IOL) dislocation [7].

This study aimed to investigate the effect of PEX on the course of PE.

## PATIENTS AND METHODS

This study was conducted at the Ophthalmology Department No. 5 of the City Multi-Field Hospital No. 2. We examined 1010 patients admitted for cataract surgery. The presence of PEX was considered fundamental in the distribution of the patients into two groups: those with PEX (main group,  $n = 580$  patients) and those without PEX (control group,  $n = 430$  patients). PEM was detected by biomicroscopy with undilated and dilated pupil or gonioscopy. The patients in the main group had pseudoexfoliation material in the anterior chamber angle, on the anterior lens capsule,

or the pupil margin of the iris. PEX was also diagnosed in the presence of its early stage in the form of a homogeneous PEM layer on the anterior capsule of the lens. Patients were diagnosed with latent PEX if the PEM layer on the anterior lens capsule could not be visualized due to insufficient medicamentous mydriasis ( $\leq 4.5$  mm), but they had signs such as pigment dispersion on the corneal endothelium, defects in the pigment leaf of the iris at transillumination, and sub-atrophy of the iris stroma. The detection of these signs in the fellow eye only was insufficient to establish a clinical diagnosis of PEX. The groups were equal in terms of sex and age (Table 1).

All patients underwent a standard preoperative ophthalmological examination. PE was performed as a method of cataract surgery by the same surgeon using the phaco chop technique (Infiniti, Alcon), with implantation of various IOL types. Possible intraoperative complications were assessed, namely Descemet's membrane detachment, the retrolental position of the lens material, posterior capsule rupture, and zonular dialysis. The classification of complications according to their severity is presented below.

We assessed the Descemet's membrane detachment and the lens material retrolental position using a point system. If Descemet membrane was detached, the detachment's severity was evaluated. If it was local, the severity corresponded to 1 point; if it was extensive, requiring introducing air into the anterior chamber, the severity corresponded to 2 points.

The surgeon assessed the retrolental lens material at the end of the procedure by a detailed examination of the anterior vitreous using the surgical microscope. The presence of a small number of dusty inclusions corresponded to 1 point, a moderate amount of dusty inclusions corresponded to 2 points, and single small fragments corresponded to 3 points.

We divided cases of zonular dialysis and posterior capsule rupture into those with vitreous prolapse and those without.

Table 1 / Таблица 1

Распределение групп пациентов по полу и возрасту  
Distribution of groups by gender and age

Indices		PEX group (main, $n = 580$ )	Group without PEX (control, $n = 430$ )	Significance of difference
Age		$73.8 \pm 3.8$	$72.9 \pm 4.1$	$P = 0.51$
Sex	Male	116 (20%)	143 (33.3%)	$P = 0.21$
	Female	464 (80%)	287 (66.6%)	

Cataract density was assessed by biomicroscopy at pupil dilated according to the Lens Opacities Classification System, version III [8].

We evaluated the main PE parameters, namely cumulative scattered ultrasound (US) energy, the amount of aspirated balanced salt solution (BSS) in ml, and the time of the surgery (from the moment the surgeon pressed the pedal of the phacomachine) in minutes. Statistical data were processed using SPSS Statistics v 20.0 (IBM Corp., Armonk, NY). Mean values and mean-square deviations were the primary indices of the statistical processing of quantitative indices. The *t*-test was used to assess the ratio of quantitative variables in 2 independent groups, whereas the construction of contingency tables was used to determine the ratio of qualitative variables.

## RESULTS

The lens nucleus density was estimated using the Lens Opacities Classification System III at biomicroscopy [8]. We compared the frequency of occurrence of different nucleus densities in groups as well

as the average score. Table 2 presents the distribution of nucleus density. For PEX patients, the presence of a dense lens nucleus was more characteristic. The average score in the PEX group was 3.5, whereas the average score in the group without PEX was 3.2 ( $P < 0.0001$ ). In patients with PEX, the density of the nucleus NC4 was most common, whereas the density of the nucleus in patients without PEX was NC3 ( $P < 0.05$ ) (Table 2).

For PE of denser nuclei in patients with PEX, it was necessary to spend more US energy. The cumulative dissipated energy of US was significantly higher in PEX patients ( $P = 0.045$ ). The amount of aspirated BSS and the time of surgery were slightly higher in the PEX group. Still, the difference did not reach the level of statistical significance ( $P = 0.32$  and  $0.22$ , respectively) (Table 3).

Within the study, Descemet's membrane detachment was local in all cases and observed in patients of both groups. However, this complication was more characteristic to the main group and occurred almost twice as often ( $P = 0.017$ ) (Table 4). A retrolental location of the lens material at the end of uncomplicated

Table 2 / Таблица 2

### Assessment of cataract density in groups (LOCS III)

#### Оценка плотности катаракты в группах пациентов (LOCS III)

Cataract density	PEX group ( <i>n</i> = 580)	Group without PEX ( <i>n</i> = 430)	Significance ( <i>P</i> value)
NC2	54 (9.3%)	60 (14%)	0.174
NC3	203 (35%)	230 (53.5%)	0.011
NC4	301 (51.9%)	132 (30.7%)	0.0001
NC5	16 (2.8%)	7 (1.6%)	0.112
NC6	6 (1%)	1 (0.2%)	0.127

Note. LOCS, Lens Opacities Classification System; PEX, pseudoexfoliation syndrome.

Table 3 / Таблица 3

### Phaco parameters in groups

#### Параметры факоэмюльсификации в группах пациентов

Indicator	PEX group	Group without PEX	Significance ( <i>P</i> value)
Cumulative scattered ultrasound energy	17.3	14.1	0.045
Amount of aspirated BSS, ml	67.6	64.8	0.32
Time of surgery, min	7.73	7.28	0.22

Note. BSS, balanced salt solution; PEX, pseudoexfoliation syndrome.

Table 4 / Таблица 4

## Intraoperative complications in groups

## Структура интраоперационных осложнений в группах

Indicator	PEX group ( <i>n</i> = 580)			Group without PEX ( <i>n</i> = 430)			Significance ( <i>P</i> value)
Descemet's membrane detachment (local)	86 (14.8%)			34 (7.9%)			0.017
Retrolental lens material	98 (16.9%)			26 (6.0%)			0.0001
	1	2	3	1	2	3	
	65 (11.2%)	33 (5.7%)	—	20 (4.7%)	6 (1.4%)	—	
Posterior capsule rupture	0			0			—
Zonular dialysis	4 (0.7%)			—			0.26
	2 (0.35%) (with vitreous body prolapse)		2 (0.35%) (without vitreous body prolapse)				

Note. PEX, pseudoexfoliation syndrome.

PE, which is a marker of relaxation of lens ligaments, was found in 16.9% of patients with PEX and only 6% of patients without PEX ( $P = 0.001$ ). There were no ruptures of the posterior capsule in either group (Table 4). Zonular dialysis was registered in four PEX patients, two of whom also experienced vitreous prolapse ( $P = 0.22$ ) (Table 4). Moreover, there was no statistically significant difference between the groups. In this case, the contingency table was used for evaluation. As in the PEX group, four patients (<1%) had zonular dialysis, and 574 did not. It is worth noting that in each of these patients, IOL was implanted in the capsular bag after preliminary implantation of the intracapsular ring. In all other cases, the intracapsular ring was not implanted.

## DISCUSSION

PEX undoubtedly complicates the task of the surgeon. This is most often due to the presence of a narrow pupil, relaxation of ligaments, and often a combination of both [5, 9–11]. Successful PE in this category of patients is based on a thorough preliminary examination, increased alertness, and compliance with several rules during surgery, as well as longer follow-up in the postoperative period.

The results of this study demonstrated that a dense lens nucleus is characteristic of PEX. In this regard, the surgeon must use more US energy. With PEX, the risk of the Descemet's membrane detachment increases, which was local in all patients in this study and did not require air to be introduced into the anterior chamber or other measures. Another

significant factor is the relaxation of ligaments of the lens, which is indicated by the appearance of small fragments of the lens material in the anterior vitreous, even during uncomplicated surgery.

There were no ruptures of the posterior capsule during the study. However, in the PEX group, there were four cases of zonular dialysis, two of which were accompanied by vitreous prolapse. This fact emphasizes once again the need to use in PEX surgical techniques that have a minimal impact on the ciliary zonules. In all cases of zonular dialysis, it was possible to straighten the capsular bag using the intracapsular ring and perform standard IOL implantation.

The preoperative assessment of the relaxation of ligaments is particularly noteworthy. Shallow anterior chamber, iridophacodonesis, zonular dialysis, and the gap between the iris and lens indicated the presence of the latter at biomicroscopy [9, 12–15]. PEM accumulations, both in the ciliary zonules and on the ciliary processes, cause the ligamentous apparatus instability [9, 16]. The literature indicated that in 8.4% to 10.6% of PEX patients, there is a subluxation of the lens of various degrees or phacodonesis [9, 13, 17, 18]. Vitreous herniation in the absence of PEX is noted five times less frequently than in the presence of PEX (9.0% and 1.8%, respectively) [19]. The latter, in turn, is associated with an increased occurrence of zonular dialysis, lens subluxation, and rupture of the lens capsule [19].

What rules must be followed during PE in the presence of PEX in a patient? First, attention should be paid to the size of capsulorrhexis owing to the fact

that its small size will contribute to additional stress on the ligamentous apparatus of the lens. Moreover, the high risk of developing capsulophimosis in the postoperative period should not be neglected, as it could cause additional stress on the ligamentous apparatus. The optimal size of capsulorrhexis is believed to be 5.5 mm. Overfilling of the anterior chamber should be avoided during hydrodissection and hydrodelineation. Rotation should be performed as carefully as possible, preferably bimanually. With severe relaxation of the ligaments, a capsular ring must be used. The choice of PE technique depends largely on the surgeon. In this study, we used the phaco chop technique, which enables the surgeon to exert minimal pressure on the ligamentous apparatus and perform all manipulations in the center of the anterior chamber. Particular attention should be given to the washout of the lens masses, which can be quite challenging when the ligamentous apparatus of the lens is relaxed and in the presence of an intracapsular ring. The general rule when performing this stage is the tangential orientation of the movements [9, 14–20].

## CONCLUSIONS

Based on our results, PE can be performed successfully in PEX patients. A large number of contemporary techniques and additional devices reduce the risk of various complications. However, this group of patients requires a more thorough preoperative examination, extra caution during surgery, and more careful and long-term postoperative follow-up. To achieve an optimal result, the surgeon must take into account all specific eye changes occurring in PEX.

## REFERENCES

- Bourne RR, Stevens GA, White RA, et al. Causes of vision loss worldwide, 1990–2010: a systematic analysis. *Lancet*. 2013;1(6): e339–e349. [https://doi.org/10.1016/S2214-109X\(13\)70113-X](https://doi.org/10.1016/S2214-109X(13)70113-X).
- Kanthan GL, Mitchell P, Burlutsky G, et al. Pseudoexfoliation syndrome and the long-term incidence of cataract surgery: the Blue Mountains eye study. *Am J Ophthalmol*. 2013;155(1):83–88.e1. <https://doi.org/10.1016/j.ajo.2012.07.002>.
- Ekström C, Botling Taube A. Pseudoexfoliation and cataract surgery: a population-based 30-year follow-up study. *Acta Ophthalmol*. 2015;93(8):774–777. <https://doi.org/10.1111/aos.12789>.
- Schöltzer-Schrehardt U. Pseudoexfoliation syndrome: the puzzle continues. *J Ophthalmic Vis Res*. 2012;7(3):187–189.
- Conway RM, Schöltzer-Schrehardt U, Küchle M, Naumann GO. Pseudoexfoliation syndrome: pathological manifestations of relevance to intraocular surgery. *Cin Exp Ophthalmol*. 2004;32(2): 199–210. <https://doi.org/10.1111/j.1442-9071.2004.00806.x>.
- Schöltzer-Schrehardt UM, Koca MR, Naumann GO, Volkholz H. Pseudoexfoliation syndrome. Ocular manifestation of a systemic disorder? *Arch Ophthalmol*. 1992;110(12):1752–1756. <https://doi.org/10.1001/archophth.1992.01080240092038>.
- Vazquez-Ferreiro P, Carrera-Hueso FJ, Poquet Jornet JE, et al. Intraoperative complications of phacoemulsification in pseudoexfoliation: meta-analysis. *J Cataract Refract Surg*. 2016;42(11): 1666–1675. <https://doi.org/10.1016/j.jcrs.2016.09.010>.
- Bencić G, Zorić-Geber M, Sarić D, et al. Clinical importance of the lens opacities classification system III (LOCS III) in phacoemulsification. *Coll Antropol*. 2005;29(Suppl 1):91–94.
- Потёмкин В.В., Агеева Е.В. Нестабильность связочного аппарата хрусталика у пациентов с псевдоэкзофолитивным синдромом: анализ 1000 последовательных факоэмульсификаций // Офтальмологические ведомости. – 2018. – Т. 11. – № 1. – С. 41–46. [Potyomkin VV, Ageeva EV. Zonular instability in patients with pseudoexfoliative syndrome: the analysis of 1000 consecutive phacoemulsifications. *Ophthalmology journal*. 2018;11(1):41–46. (In Russ.).] <https://doi.org/10.17816/OV11141-46>.
- Hashemi H, Seyedian MA, Mohammadpour M. Small pupil and cataract surgery. *Curr Opin Ophthalmol*. 2015;26(1):3–9. <https://doi.org/10.1097/ICU.0000000000000116>.
- Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF. Capsular tension ring implantation after capsulorrhexis in phacoemulsification of cataracts associated pseudoexfoliation syndrome; intraoperative complications and early postoperative findings. *J Cataract Refract Surg*. 2001;27(10):1620–1628. [https://doi.org/10.1016/s0886-3350\(01\)00965-8](https://doi.org/10.1016/s0886-3350(01)00965-8).
- Jacob S, Agarwal A, Agarwal A, et al. Efficacy of a capsular tension ring for phacoemulsification in eyes with zonular dialysis. *J Cataract Refract Surg*. 2003;29(2):315–321. [https://doi.org/10.1016/s0886-3350\(02\)01534-1](https://doi.org/10.1016/s0886-3350(02)01534-1).
- Küchle M, Viestenz A, Martus P, et al. Anterior chamber depth and complications during cataract surgery in eyes with pseudoexfoliation syndrome. *Am J Ophthalmol*. 2000;129(3):281–285. [https://doi.org/10.1016/s0002-9394\(99\)00365-7](https://doi.org/10.1016/s0002-9394(99)00365-7).
- Jehan FS, Mamalis N, Crandall AS. Spontaneous late dislocation of intraocular lens within the capsular bag in pseudoexfoliation patients. *Ophthalmology*. 2001;108(10):1727–1731. [https://doi.org/10.1016/s0161-6420\(01\)00710-2](https://doi.org/10.1016/s0161-6420(01)00710-2).
- Kaštelan S, Bušić M. Pseudoexfoliation syndrome and cataract surgery. *Ophthalmologia Croatica*. 2003;11:37–40.
- Freissler K, Küchle M, Naumann GO. Spontaneous dislocation of the lens in pseudoexfoliation syndrome. *Arch Ophthalmol*. 1995;113(9):1095–1096. <https://doi.org/10.1001/archophth.1995.01100090017008>.
- Naumann GO, Küchle M, Schönherr U. [Pseudo-exfoliation syndrome as a risk factor for vitreous loss in extra-capsular cataract extraction. The Erlangen eye information group. (In German.)]. *Fortschr Ophthalmol*. 1989;86(6):543–545.
- Schöltzer-Schrehardt U, Naumann GO. A histopathologic study of zonular instability in pseudoexfoliation syndrome. *Am J Ophthalmol*. 1994;118(6):730–743. [https://doi.org/10.1016/s0002-9394\(14\)72552-8](https://doi.org/10.1016/s0002-9394(14)72552-8).



19. Busić M, Kastelan S. Pseudoexfoliation syndrome and cataract surgery by phacoemulsification. *Coll Antropol*. 2005;29(Suppl 1): 163-166.
20. Malyugin B. Small pupil phaco surgery: a new technique. *Ann Ophthalmol (Skokie)*. 2007;39(3):185-193. <https://doi.org/10.1007/s12009-007-0023-8>.

---

#### Information about the authors

**Vitaly V. Potyomkin** — PhD, Assistant Professor, Department of Ophthalmology, Academician I.P. Pavlov First Saint Petersburg State Medical University; Ophthalmologist, City Hospital No. 2, Saint Petersburg, Russia. E-mail: [potem@inbox.ru](mailto:potem@inbox.ru).

**Elena V. Goltzman** — ophthalmologist. City Hospital No. 2, Saint Petersburg, Russia. E-mail: [ageeva\\_elena@inbox.ru](mailto:ageeva_elena@inbox.ru).

---

#### Сведения об авторах

**Виталий Витальевич Потёмкин** — канд. мед. наук, доцент кафедры офтальмологии. ФГБОУ ВО «ПСПбГМУ им. И.П. Павлова» Минздрава России; врач-офтальмолог. СПбГБУЗ «ГМБ № 2», Санкт-Петербург. E-mail: [potem@inbox.ru](mailto:potem@inbox.ru).

**Елена Владимировна Гольцман** — врач-офтальмолог. СПбГБУЗ «ГМБ № 2», Санкт-Петербург. E-mail: [ageeva\\_elena@inbox.ru](mailto:ageeva_elena@inbox.ru).