# THE COMPLICATIONS OF CATARACT SURGERY IN PATIENTS WITH PSEUDOEXFOLIATION

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Received: 02.09.2020.
Accepted: 20.10.2020.

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UDK: 617.741-004.1-089
Eabr 2023; 24(4):323-328
DOI: 10.2478/sjecr-2020-0044

## ABSTRACT

*The senile cataract represents the blurring of the crystalline lens after the age of 65. It occurs due to metabolic changes in the crystalline lens which occur over the years. The only effective way to treat cataract is the surgical one. Pseudoexfoliation is an age related systemic disorder. PEX represents the accumulation fibrillar material in the extracellular matrix of the tissue. The most known ocular manifestation of the PEX are the collection at iris pupillary margin and anterior lens capsule. This accumulation is associated with many intraoperative and postoperative complications in patients scheduled for cataract surgery. The aim of the study was to investigate the prevalence of the surgical complications during phacoemulsfication in patients with PEX. The study included 91 patients scheduled for cataract surgery divided into two groups (PEX group 46, control group 45 patients). Poor intraoperative midryasis, zonular dehiscence, postoperative corneal edema, anterior chamber inflammation, elevated intraocular pressure and tear film instability had particularly higher rate of occurring in PEX group comparing to the control group ($p<0.001$). The highest mean value of intraocular pressure was observed in PEX group on the first postoperative day 25.6 ± 1.1 mmHg, while the best corrected visual acuity was measured in control group 0.71 ± 1.2 one month after phacoemulsification. Cataract surgery in patients with PEX carries great risk, but with adequate preoperative planning, the awareness of the potential complications, can provide safe and routine phacoemulification in these patients.*

***Keywords***: *Cataract, pseudoexfoliation, complication, glaucoma.*

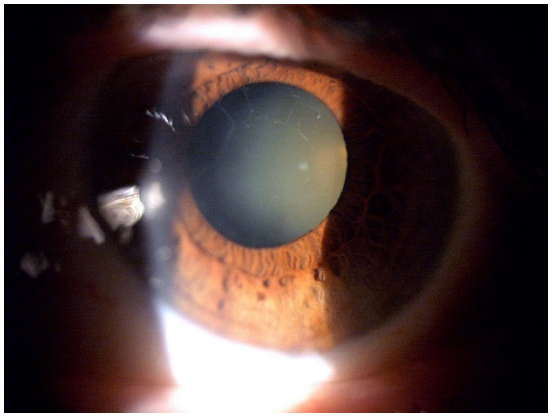
## INTRODUCTION

The senile cataract represents the blurring of the crystalline lens after the age of 65. It occurs due to metabolic changes in the crystalline lens which occur over the years (1). The only effective way to the treat cataract is the surgical one (2). Through the centuries the surgical technique was improving. In the last few decades cataract surgery is based on usage of ultrasound energy to aspirate the cataract. This technique is known as phacoemulsification (3). Cataract still remains the worlds' leading cause of reversible blindness in the elderly population. Knowing that senile cataract begins to develop in every person above the 65 years old, explains why the phacoemulsification is the most common surgical procedure worldwide (4).

Pseudoexfoliation (PEX) is an age related systemic disorder. It affects many visceral organs and blood vessels. PEX represents the accumulation of fibrillar material in the extracellular matrix of the tissue (5). PEX shows a strong geographic presentation. It is a very common condition in Scandinavia, where its incidence is over 22%, while in Chine its rate is about 0.5% (6). In the eye, PEX is found in the conjunctiva, cornea, anterior chamber, iris, anterior lens capsule, ciliary body, zonules (Figure 1). This condition is described as a pseudoexfolation syndrome (7). The most known ocular manifestations of PEX are the accumulation at iris pupillary margin and anterior lens capsule. By blocking the trabecular meshwork PEX aggravates the aqueous humour outflow, which leads to the intraocular pressure (IOP) rise. That is followed by a characteristic visual field defects and optic nerve damage. This condition in known as pseudoexfolation glaucoma (XGF) (8). It is also reported that patients with PEX are in a higher risk to develop a senile nuclear cataract (5). The presence of PEX in conjunctival goblet cells, corneal endothelium, iris and zonule can have a huge effect at cataract surgery. The accumulation of PEX in these tissues is associated with many intraoperative and postoperative complications in patients scheduled for cataract surgery (9) (10) (11).

The aim of this study was to investigate the prevalence of the surgical complications during phacoemulsfication in patients with PEX.

**Figure 1.** PEX



## PATIENTS AND METHODS

The study was prospective and carried out between January 2019 and January 2020 at the Clinic of Ophthalmology, Kragujevac Clinical Center, Kragujevac, Serbia. It included 91 patients scheduled for cataract surgery. For the research, in every patient only one eye was included in the study, so the total number of eyes were equal to the number of the patients (n=91). Participants were divided into two groups depending on presence of pseudoexfoliation. The first group included 46 patients with diagnosed pseudoexfoliation syndrome. The second group included 45 patients without presence of the pseudoexfoliation.

The most important criterion was the presence of the senile cataract. Patients with another type of cataract, such as presenile, traumatic, iatrogenic, metabolic, congenital, were excluded from the study. Visual acuity in every patient before the surgery had to be 0.2 by Snellen chart and lower. Patients with previous history of intraocular surgery, dry eye, glaucoma, uveitis, keratitis, laser treatment, conjunctival or corneal degeneration, were also excluded from the study. Those patients who underwent some other type of cataract surgery, such as extracapsular or intracapsular cataract extraction, also could not participate in the investigation. Patient with preoperative zonular dehiscence, lens subluxation, vitreous body loss were excluded. With the approval of the institutional Ethics Committee and according to the tenets of the Declaration of Helsinki, all the patients gave their written consent at the beginning of the study.

Before the surgery all the patients passed complete ophalmological examination (best corrected visual acuity, intraocular pressure measurement, detailed slit-lamp examination, retinal examination, ocular ultrasonography). Using the slit-lamp a presence of the PEX were carefully analysed. Patients who were suspected having a glaucoma passed additional retinal examination, visual field testing and central corneal thickness measurement. Dry eye tests were also performed. We used Schirmer test to measure the quantity of the tear film. The test strips were placed in the lateral part of the inferior conjunctival fornix. Values shorter than 5 mm, after 5 minutes, indicated a dry eye syndrome. The quality of the tear film was investigated by using tear breakup time test (TBUT). This test is the indicator of the lipid layer of the tear film. The test is based on usage of the cobalt blue light of the slit lamp biomicroscope and fluorescein strips. After the staining of the corneal surface with fluorescein, time until the first dry spots appear were counted. Values under 10 seconds were considered as pathological.

Five days before the phacoemulsification 0.3% solution of ofloxacin was administrated in every patient (sol Floxal®, Dr.Gerhard Mann, Chem.-Pharm. Fabric GmbH, Berlin, Germany). All the cataract surgeries were performed by one experienced surgeon. Phaco machine for all surgeries was Stellaris (Bausch & Lomb, Rochester, NY, USA). On the surgery day, maximal mydriasis was achieved applying topical phenylephrine hydrochloride ophthalmic solution 2.5%.

Tetracaine eye drops was the only anesthetic drug used during the surgery. Sterile ruler was used to measure the maximum achieved intraoperative mydriasis. Main corneal incision and paracentesis were made using 2.75mm and 1.5 mm wide surgical knifes. If it was necessary, due to better visualisation, anterior lens capsule was stained using trypan blue solution. A cohesive viscoelastic then fulfilled the anterior chamber. Continuous curvilinear capsulorhexis, hydrodisection and nucleus rotation followed. When the nucleus was completely separated from the lens capsule, the "stop and chop" and "divide and conquer" technique were used to crack the nucleus. The remaining lens cortex was aspirated using bimanual irrigation and aspiration. When the capsular bag was cleared, cohesive viscoelastic was again injected, and foldable monofocal artificial intraocular lens (IOL) was implanted in capsular bag with adequate injector. In cases where capsular bag was not intact, such as posterior capsule rupture, or zonular dehiscence, anterior chamber intraocular lens was implanted. Then viscoelastic was aspirated and intracameral solution of cefuroxime with 1 mg / 0.1 ml balanced salt solution was injected (sol. Nilacef®, Hemofarm A.D., Vršac, Serbia). The main corneal incision and paracentesis were hydrated by balanced salt solution using a blunt injection needle. Postoperatively, dexamethasone tobramycin eye drops (Tobradex®, Alcon-Couvreur NV, Puurs, Belgium) was administrated five times per day for one month.

Detailed opthalmological examination was repeated on the first postoperative day, and then three, six and twelve months after cataract surgery. Using a Snellen charts best corrected visual acuity was calculated in every patient during one year follow-up period.

IBM SPSS version 22.0 was used for the statistical analysis in the study. According to the normality of distribution, paired t-test, $\chi 2$, Person test, Mann-Whitney test, were utilized in analyzing associations between the continuous variables (BCVA, IOP, dry eye tests, patients' demographic characteristics). Categorical variables were expressed as frequencies. Values $p<0.05$ and $p<0.001$. were considered to be statistically significant.

## RESULTS

The PEX group consisted of 24 female and 22 male patients. The mean age in this group was 75.6 ± 7.1 years (range 67 - 82 years). The control group included 23 female and 22 male participants. The mean age was 69.3 ± 4.5 (range 65 - 78 years). No statistical significance was noticed in sex distribution among groups (p=0.784). Statistically significant difference was recorded in patients' age. Patients from the first group were statistically significantly older compared to those from the control group (p=0.034).

Intraoperative complications in both groups are shown in Table 1. As it can be seen, statistically significantly difference among groups was observed in every intraoperative complication measured in the study. The highest statistically difference was recorded in pupil diameter and zonular dehiscence.

**Table 1.** Intraoperative complications in PEX group and control group

| **Intraoperative complications** | **PEX group** number of patients (%) | **Control group** number of patients (%) | **p value** |
|---|---|---|---|
| Maximal midryasis (mm) | 5.02 ± 0.6 | 6.72 ± 0.7 | p<0.001* |
| Posterior capsule rupture | 6 (13.04 %) | 2 (4.44%) | p=0.031* |
| Vitreous body loss | 3 (6.52%) | 1 (2.22%) | p=0.038* |
| Zonular dehiscence | 5 (10.86%) | 2 (4.33%) | p=0.006* |
| Intraoperative miosis | 10 (21.73%) | 7 (15.56%) | P=0.017* |

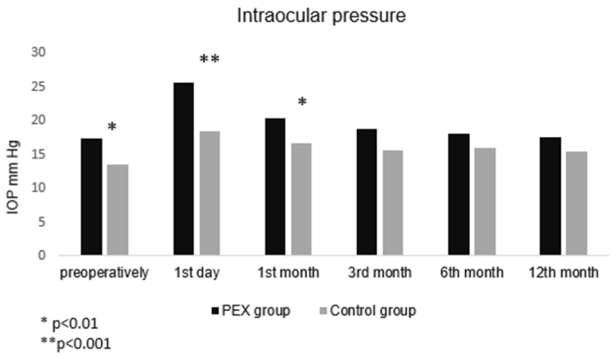
**Table 2.** Postoperative complications in PEX group and control group

| **Postoperative complications** | **PEX group** number of patients (%) | **Control group** number of patients (%) | **p value** |
|---|---|---|---|
| Cystoid macular edema | 3 (6.52%) | 2 (4.44%) | p=0.065 |
| Nucleus fragment dislocation | 2 (4.34%) | 1 (2.22%) | p=0.052 |
| Posterior lens capsule opacification | 0.09 ± 0.02 | 0.08 ± 0.025 | p=0.065 |
| Corneal edema | 9 (19.56%) | 5 (11.11%) | p=0.016* |
| Retinal detachment | 0 | 1 (2.22%) | p=0.317 |
| IOL decentration | 2 (4.34%) | 1 (2.22%) | p=0.057 |
| Anterior chamber inflammation | 10 (21.73%) | 4 (15.55%) | p=0.021* |

Postoperative complications were also more frequent in PEX group (Table 2). Especially high statistical significance was noticed in the incidence of postoperative corneal edema and anterior chamber inflammation. Other measured complications were not statistically significant. Possible postoperative complications, such as suprachoroidal hemorrhage, endophthalmitis were not noticed in any patient during the follow-up period.

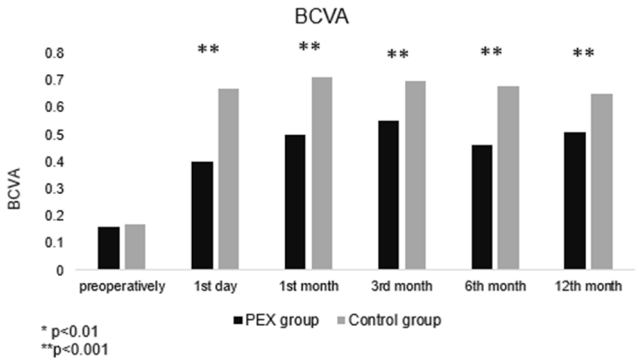
Intraocular pressure values were higher in PEX groups during all measurements. The first three visit showed statistically significantly difference among the groups, with the highest difference one month after phacoemulsification (Figure 2).

**Figure 2.** Intraocular pressure during the study



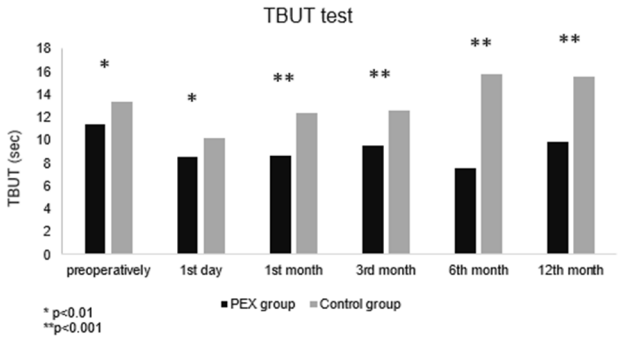

Best corrected visual acuity was similar at the beginning of the investigation (I group: 0.16 ± 0.02; II group: 0.17 ± 0.01; p=0.124). From that moment until the end of follow-up period high statistical significance maintained among the groups (Figure 3).

**Figure 3.** Best corrected visual acuity during the study




Tear break up time test seemed to be the test with the highest difference between the PEX and the control group. Statistical significance was present before the phacoemulsification and remained in that way for the next twelve months (Figure 4).

**Figure 4.** Tear break up time test during the study




Unlike to TBUT test, Schirmer test showed no statistical difference among the groups during the whole period of the study. Preoperatively Schirmer test values in both groups were above 10 mm (I group 22.45 ± 1.2 mm, II group=20.12 ± 0.8 mm, p=0.065). On the first postoperative day PEX group had mean value 26.12 ± 2.2 mm, while control group had 25.57 ± 2.1 mm, again without statistical significance, p=0.078. This trend continued during next four measurements, one month after the cataract surgery (I group: 20.12 ± 0.8 mm, II group: 21.56 ± 1.2 mm) three months (I group: 18.14 ± 2.4 mm, II group: 19.10 ± 1.1 mm), six months (I group: 17.47 ± 2.2 mm, II group: 18.78 ± 2.4 mm) and twelve months (I group: 20.32 ± 4.2 mm; II group: 19.68 ± 2.6 mm).

## DISCUSSION

Cataract surgery is the most common surgical procedure worldwide. Still it is not completely without risk (12). The presence of PEX makes this risk even higher. Our results strongly indicated that the accumulation of this fibrillar material in ocular tissue was associated with higher incidence of all possible intraoperative complications. These results are in a correlation with earlier investigations (6) (10).

Particularly high statistical significance was noticed in pupil diameter, zonular dehiscence and intraoperative miosis among the groups. PEX is usually located in iris and ciliary zonule, causing the iris atrophy and zonular weakness (13). That fact requires extreme caution and precision during the phacoemulsification. Our study also revealed a higher rate of posterior capsule rupture in PEX group, which could be consequence of poor mydriasis and zonular instability during phacoemulsification.

Cataract surgery breaks down the hemato-ocular barrier releasing the proinflammatory mediators in humour aqueous (14). It is believed that inflammation in anterior chamber is responsible, as well as the remaining viscoelastic, for the intraocular pressure rise after phacoemulsification. Our results are similar with the previous studies (15) (16). In PEX patients there is a higher rate of inflammation due to presence of pseudoexfoliation in anterior chamber. Subsequently, by blocking the trabecular meshwork, PEX causes increased rise of IOP after the cataract surgery. IOP values were constantly increased in PEX group during the study with the highest

statistical significance one month after phacoemulsification ($p<0.001$).

Phacoemulsification technique is based on using ultrasound energy to crack the lens nucleus and aspirate it. This energy also disturbs the corneal endothelial cells (17). It is known that these cell are responsible in maintaining the cornea transparency by pumping the ions to anterior chamber. Lower number of endothelial cells leads to water influx and the development of corneal edema (18). Deposition of PEX material in corneal endothelial cells decreases their morphology and function, which could be the reason for the higher rate of postoperative corneal edema in PEX patients in our study. That is the explanation, including all other intraoperative and postoperative complications, for the statistically significantly lower postoperative BVCA in PEX group which is shown in Figure 3.

Dry eye tests indicated the presence of the dry eye after the surgery of cataract. Statistical difference in tear film stability were noticed even preoperatively among the groups. That could be explained by the presence of PEX material in conjunctival goblet cell which disturbs their function. Phacoemulsification can cause the development of dry eye by many ways: transection of corneal nerves, exposure to the microscopic light, by releasing proinflammatory mediators. During the first postoperative month we recorded pathological values of TBUT test in both groups, while the Schirmer test results were even compensatory increased. After that period patients from control group managed to increase their tear film stability. Dry eye remained present in PEX group during the end of follow-up period.

## CONCLUSION

Patients with PEX had more frequent occurrence of the intraoperative and postoperative complications. Poor intraoperative midryasis and zonular dehiscence, postoperative corneal edema and anterior chamber inflammation had particularly higher rate of development comparing to the control group. Elevated IOP and tear film instability were worse in PEX group as well. All these factors can disrupt the final outcome of the surgery and patient's satisfaction. Phacoemulsification has improved cataract surgery in all aspects, but even this technique is not without risks. Our investigation revealed potential risks in patients with pseudoexfoliation syndrome scheduled for cataract surgery. Adequate preoperative planning, the awareness of the potential intraoperative and postoperative complications, can provide safe and routine phacoemulification in these patients.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted in accordance with the Declaration of Helsinki. The protocol of the study was approved by the Ethical committee from the Clinical Center Kragujevac. Each patient gave informed consent to participate in the study.

## CONFLICT OF INTEREST

None.

## ACKNOWLEDGEMENT

This work was supported by the Faculty of Medical Sciences, University of Kragujevac, Serbia (Grants JP 05/11).

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