EFFECTS OF CATARACT SURGERY ON SHORT-TERM AND LONG-TERM INTRAOCULAR PRESSURE FLUCTUATIONS IN NON-GLAUCOMATOUS AND MEDICALLY CONTROLLED PRIMARY OPEN-ANGLE GLAUCOMA PATIENTS

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Summary

Introduction. It has been recognized that cataract surgery leads to a reduction of intraocular pressure, both in healthy and in glaucoma patients. This prospective interventional clinical study aimed to investigate the effects of cataract surgery on intraocular pressure and its short- and long-term fluctuations in medically controlled primary open-angle glaucoma patients and non-glaucamatos patients. Material and Methods. Two groups of 31 patients (31 eyes) were studied. The observed group included patients with glaucoma and cataract, and the control group included patients with senile cataract only. The intraocular pressure was measured three times daily pre- and at 1, 3 and 6 months postoperatively. Results. In both groups, a significant postoperative reduction in both mean and maximum intraocular pressure. Six months after surgery, in the observed group the average and maximum intraocular pressure reduction levels were -2.73 ± 1.91 mmHg and -3.16 ± 2.19 mmHg, and -2.26 ± 1.71 mmHg and -2.53 ± 1.70 mmHg in the control group. In the observed group, at 3 and 6 months after surgery, a significant reduction in short-term fluctuations was observed. Six months after surgery, short-term fluctuations decreased by -1.04 ± 2.20 mmHg compared to preoperative. Postoperatively, in the observed group, long-term fluctuations of average and maximum intraocular pressure were 2.69 ± 2.15 mmHg and 2.88 ± 2.22 mmHg, respectively, and in the controls they were 2.02 ± 1.28 mmHg and 2.42 ± 1.47 mmHg, showing no significant differences between groups. Conclusion. In patients with primary open-angle glaucoma, cataract surgery results in a statistically significant reduction in both average and maximum intraocular pressure as well as of short-term fluctuations.

Key words: Phacoemulsification; Cataract; Intraocular Pressure; Glaucoma, Open-Angle; Time Factors

Sažetak

Uvod. Poznato je da se operacijom katarakte postiže sniženje intraokularnog pritiska, kako kod zdravih tako i kod obolelih od različitih oblika glaukoma. Cilj ove opšte intervencijske kliničke studije bio je da ispitamo uticaj operacije katarakte na intraokularni pritisak i njegove kratkoročne i dugoročne fluktuacije kod medicinskim lečenih obolelih od primarnog glaukoma otvorenog uga u postoperativnom obdobju. Materijal i metode. Formirane su dve grupe od po 31 paciente (31 oko). Postoperativne diverse su bile u grupama pre i posle operacije. U posmatranoj grupi, transkrustalni pritisak iznosilo je -2.73 ± 1.91 mmHg i -3.16 ± 2.19 mmHg, a u kontrolnoj, -2.26 ± 1.71 mmHg i -2.53 ± 1.70 mmHg, redom. U posmatranoj grupi, u toku trećeg i šestog meseca, nastupila je statistički značajna redukcija, a u kontrolnoj grupi, u toku šestog meseca, stagnirala je statistički značajna redukcija. U šestom mesecu, redakoronočne fluktuacije bile su niže za -1,04 ± 2,20 mmHg u porodjenju sa preoperativnim. Dugoročne fluktuacije s narančasto i minimalnog intraokularnog pritiska u posmatranoj grupi, postoperativno, iznosile su 2,69 ± 2,15 mmHg i 2,88 ± 2,22 mmHg, redom, a u kontrolnoj, 2,02 ± 1,28 mmHg i 2,42 ± 1,47 mmHg, redom, bez statistički značajne razlike između grupa. Zaključak. Kod obolelih od primarnog glaukoma otvorenog uga operacija katarakte dovodi do statistički značajnog smanjenja i energetičkog i minimalnog intraokularnog pritiska i kratkoročnih fluktuacija.

Ključne reči: fakoemulzifikacija; katarakta; intraokularni pritisak; glaukom otvorenog uga; vremenski faktori

Introduction

Primary open-angle glaucoma (POAG) is the most common type of glaucoma, accounting for 74% of all patients with glaucoma [1]. Elevated intraocular pressure (IOP) is considered to be the most important risk factor for the development and progression of glaucomatos optic neuropathy, and

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referred for elective senile cataract surgery without
A control group, named
structural and functional changes defined by POAG.
clinically significant cataract and earlier detected
made. An experimental group, named
ration. Two groups of 31 patients (31 eyes) were
carried out in accordance with the Helsinki Decla
ska, Bosnia and Herzegovina. The study was ap
University Clinical Center of the Republic of Srp
clinical study conducted at the Eye Clinic of the
patients were included in a prospective interventional

discussion of this paper suggests that cataract surgery will lead to reduction of IOP
its short-term and long-term fluctuations in medi

evidence to suggest cataract surgery as a treatment
POAG subtype.
The patient’s name, surname, age, gender, best
corrected visual acuity (BCVA) measured by using
Snellen optotype (value in decimal), gonioscopic
grading system (Shaffer grade in scale), openness
grade, IOP measured with Goldmann applanation
tonometer, and diurnal IOP curve test (IOP mea
measurement at 07:30, 13:30 and 19:30), and the number
and type of glaucoma therapy were reported.
The maximum (Max.IOP) and minimum IOP
(Min.IOP) were determined from the daily IOP
curve. The following formulas were used:
Average IOP (AVIOP) = (IOP_{07:30} + IOP_{13:30} +
IOP_{19:30}) / 3
Short-term IOP fluctuation = Max.IOP – Min.IOP
The long-term fluctuation (5-month period) of
the average and maximum IOP was calculated as the
difference between the highest and the lowest
mean of three measurements obtained at 1, 3 and 6
months after surgery.
Phacoemulsification (in-the-bag, phaco chop) tech
ique was performed in one eye of all patients under
topical anesthesia, using the Stellaris Vision Enhance
ment System (Bausch & Lomb) and intraocular lens
(Akreos Adapt AO, Bausch & Lomb) was implanted.
Eye selection was based on the worse BCVA. Phacoem
ulsification parameter Absolute phaco time were
noted at the end of surgery and evaluated.
In order to avoid potential effects of altered
topical antiglaucoma therapy on postoperative IOP,
all POAG patients postoperatively continued using
their preoperatively used antiglaucoma therapy.
Clinical examinations, diagnostic measurements
and all surgeries were performed by the same sur
geon (B.M.)
Statistical analysis was performed using IBM
SPSS Statistics 21.0 software. The Pearson’s chi
square test, Student’s t-test, Mann-Whitney U test,
Wilcoxon signed-rank test and Pearson’s correlation
efficient test were used. Data were statistically
processed and p < 0.05 was considered statistically
significant.

Results
The study included 62 patients, of which 30
(48.39%) women and 32 (51.61%) men. The mean
age for the POAG + Cataract group was 74.35 ±
9.75 (range 44.0 - 88.0) and for the Cataract group 71.90 ± 7.10 (range 54.0 - 83.0), without a significant difference between the groups (p = 0.059, Mann-Whitney U test).

There were no significant differences between the groups in preoperative BCVA, as well as at 1, 3 and 6 months after surgery (p = 0.117; P = 0.170; p = 0.508; p = 0.232, respectively; Mann-Whitney U test).

Table 1. The average IOP, the maximal IOP and the short-term IOP fluctuations according to the diurnal IOP curve before surgery and during the post-operative monitoring period

| Group       | Av. IOP (mmHg) Mean ± SD (range) | Max. IOP (mmHg) Mean ± SD (range) | Short-term IOP fluctuation (mmHg) Mean ± SD (range) |
|-------------|----------------------------------|----------------------------------|----------------------------------|
| POAG + Cat. | 17.19 ± 1.81 (13.7 - 21.1)       | 18.80 ± 2.21 (14.0 - 25.0)       | 3.35 ± 1.68 (0.3 - 6.8)          |
| Cataract    | 14.53 ± 2.04 (10.7 - 19.7)       | 15.96 ± 2.19 (12.1 - 20.3)       | 2.79 ± 1.46 (0.0 - 5.4)          |

1 month after surgery/1 mesec nakon operacije

| POAG + Cat. | 16.08 ± 2.47 (10.2 - 21.4)       | 17.36 ± 2.77 (11.7 - 23.8)       | 2.66 ± 1.37 (0.2 - 5.7)          |
| Cataract    | 13.53 ± 2.22 (9.6 - 17.6)        | 14.76 ± 2.43 (10.1 - 19.6)       | 2.41 ± 1.34 (0.3 - 4.7)          |

3 months after surgery/3 meseca nakon operacije

| POAG + Cat. | 14.79 ± 2.35 (9.3 - 18.9)        | 15.71 ± 2.45 (9.8 - 19.5)        | 1.96 ± 1.22 (0.2 - 4.5)          |
| Cataract    | 12.09 ± 2.03 (7.7 - 15.6)        | 13.29 ± 2.45 (8.1 - 17.9)        | 2.39 ± 1.08 (0.9 - 4.8)          |

6 months after surgery/6 meseci nakon operacije

| POAG + Cat. | 14.47 ± 2.06 (10.1 - 18.9)       | 15.64 ± 2.12 (9.8 - 19.5)        | 2.32 ± 1.07 (0.3 - 4.9)          |
| Cataract    | 12.27 ± 1.89 (9.4 - 15.8)        | 13.43 ± 2.04 (10.2 - 16.6)       | 2.24 ± 1.17 (0.3 - 4.9)          |

Legend: POAG – primary open-angle glaucoma; Av. – average; IOP – intraocular pressure; Max. – maximal; SD – standard deviation; * - Student’s t-test

Table 2. Results of Student’s t-test for statistical reduction of the average IOP, maximal IOP and short-term IOP fluctuations in the postoperative follow-up period in relation to pre-operative values

| p (Student’s t-test)/p (Student-ov t-test) | Average IOP | Maximal IOP | Short-term IOP fluctuation |
|-------------------------------------------|-------------|-------------|---------------------------|
| POAG + Cat. Cataract                      | 0.041       | 0.003       | 0.024                     |
| POAG + Cat. Cataract                      | 0.001       | 0.001       | 0.001                     |
| POAG + Cat. Cataract                      | 0.122       | 0.001       | 0.014                     |

Legend: POAG – primary open-angle glaucoma; Cat. – Cataract; IOP – intraocular pressure

The average IOP, the maximal IOP and the short-term IOP fluctuations according to the diurnal IOP curve before surgery and during the post-operative monitoring period.

Table 1. Prosečni intraokularni pritisak, maksimalni intraokularni pritisak i kratkoročne fluktuacije intraokularnog pritiska na osnovu dnevne krive pre operacije i u postoperativnom periodu praćenja

| Grupa (n) | Av. IOP (mmHg) prosek ± SD (raspon) | Max. IOP (mmHg) prosek ± SD (raspon) | Short-term IOP fluctuation (mmHg) prosek ± SD (raspon) |
|-----------|------------------------------------|-------------------------------------|----------------------------------------------------------|
| POAG + Cataract (n=31) | 17.19 ± 1.81 (13.7 - 21.1) | 18.80 ± 2.21 (14.0 - 25.0) | 3.35 ± 1.68 (0.3 - 6.8) |
| Cataract (n=31) | 14.53 ± 2.04 (10.7 - 19.7) | 15.96 ± 2.19 (12.1 - 20.3) | 2.79 ± 1.46 (0.0 - 5.4) |

1 month after surgery/1 mesec nakon operacije

| POAG + Cataract (n=31) | 16.08 ± 2.47 (10.2 - 21.4) | 17.36 ± 2.77 (11.7 - 23.8) | 2.66 ± 1.37 (0.2 - 5.7) |
| Cataract (n=31) | 13.53 ± 2.22 (9.6 - 17.6) | 14.76 ± 2.43 (10.1 - 19.6) | 2.41 ± 1.34 (0.3 - 4.7) |

3 months after surgery/3 meseca nakon operacije

| POAG + Cataract (n=31) | 14.79 ± 2.35 (9.3 - 18.9) | 15.71 ± 2.45 (9.8 - 19.5) | 1.96 ± 1.22 (0.2 - 4.5) |
| Cataract (n=31) | 12.09 ± 2.03 (7.7 - 15.6) | 13.29 ± 2.45 (8.1 - 17.9) | 2.39 ± 1.08 (0.9 - 4.8) |

6 months after surgery/6 meseci nakon operacije

| POAG + Cataract (n=31) | 14.47 ± 2.06 (10.1 - 18.9) | 15.64 ± 2.12 (9.8 - 19.5) | 2.32 ± 1.07 (0.3 - 4.9) |
| Cataract (n=31) | 12.27 ± 1.89 (9.4 - 15.8) | 13.43 ± 2.04 (10.2 - 16.6) | 2.24 ± 1.17 (0.3 - 4.9) |

Legend: POAG – primarni glaukom otvorenog ugla; Av.- prosek; IOP – intraokularni pritisak; Max. – maksimalan; SD – standardna devijacija; * - Studentov t-test

Table 2. Rezultati Studentovog t-testa za statističko smanjenje prosečnog intraokularnog pritiska, maksimalnog intraokularnog pritiska i kratkoročnih fluktuacija intraokularnog pritiska u postoperativnom periodu praćenja u odnosu na preoperativne vrednosti

| p (Student-ova t-test) | Average IOP | Maximal IOP | Short-term IOP fluctuation |
|------------------------|-------------|-------------|---------------------------|
| POAG + Cat. Cataract   | 0.041       | 0.003       | 0.024                     |
| POAG + Cat. Cataract   | 0.001       | 0.001       | 0.001                     |
| POAG + Cat. Cataract   | 0.122       | 0.001       | 0.014                     |

Legend: POAG – primarni glaukom otvorenog ugla; Cat. – katarakta; IOP – intraokularni pritisak

Table 2. Results of Student’s t-test for statistical reduction of the average IOP, maximal IOP and short-term IOP fluctuations in the postoperative follow-up period in relation to pre-operative values

| p (Student’s t-test) | Average IOP | Maximal IOP | Short-term IOP fluctuation |
|----------------------|-------------|-------------|---------------------------|
| POAG + Cat. Cataract | 0.041       | 0.003       | 0.024                     |
| POAG + Cat. Cataract | 0.001       | 0.001       | 0.001                     |
| POAG + Cat. Cataract | 0.122       | 0.001       | 0.014                     |

Legend: POAG – primary open-angle glaucoma; Av. – average; IOP – intraocular pressure; Max. – maximal; SD – standard deviation; * - Student’s t-test

Table 1. The average IOP, the maximal IOP and the short-term IOP fluctuations according to the diurnal IOP curve before surgery and during the post-operative monitoring period

| Group       | Average IOP | Maximal IOP | Short-term IOP fluctuation |
|-------------|-------------|-------------|---------------------------|
| POAG + Cat. | 0.041       | 0.003       | 0.024                     |
| POAG + Cat. | 0.001       | 0.001       | 0.001                     |
| POAG + Cat. | 0.122       | 0.001       | 0.014                     |
In both groups, a significant increase in mean BCVA was observed postoperatively compared to baseline (p < 0.001; Wilcoxon’s test). Mean preoperative BCVA in the POAG + Cataract group was 0.22 ± 0.15 (range 0.0 - 0.5) and in the Cataract group 0.16 ± 0.15 (range 0.0 - 0.6). Mean postoperative BCVA at the 6th month in the POAG + Cataract group was 0.93 ± 0.13 (range 0.5 - 1.0) and in the Cataract group 0.97 ± 0.06 (range 0.8 - 1.0).

The mean values of the Av.IOP as well as Max. IOP were significantly higher in the POAG + Cataract group preoperatively, as well as on each postoperative measurement. A significant reduction in the mean Av.IOP and mean Max.IOP was observed during the postoperative follow-up compared to baseline.

There was no significant difference in the mean short-term IOP fluctuation between the examined groups neither pre- nor post-surgery. A significant reduction in mean short-term IOP fluctuations at 3 and 6 months after surgery was observed in the POAG + Cataract group, compared to baseline. The above results are shown in Table 1, Table 2 and Graph 1.

The correlation between preoperative Max.IOP and IOP was investigated 6 months after surgery. The Pearson's coefficient showed a moderate negative correlation (r1 = -0.54) in the POAG + Cataract group, and a relatively weak negative correlation (r2 = -0.44) in the Cataract group. Graph 2 shows the linear regression analysis for the POAG + Cataract group.

| Group         | Mean ± Standard Deviation | Median (interquartile range) | Minimum – Maximum | Mann-Whitney U test p-value |
|---------------|---------------------------|------------------------------|-------------------|-----------------------------|
| **Long-term fluctuations of the Av.IOP in the postoperative period (mmHg)** |                           |                             |                   |                             |
| POAG + Cat.   | 2.69 ± 2.15               | 2.5 (1.0, 3.3)               | 0.3 - 11.4        | 0.218                       |
| Cataract      | 2.02 ± 1.28               | 1.9 (1.1, 3.0)               | 0.1 - 4.7         |                             |
| **Long-term fluctuations of the Max.IOP in the postoperative period (mmHg)** |                           |                             |                   |                             |
| POAG + Cat.   | 2.88 ± 2.22               | 2.3 (1.7, 3.5)               | 0.5 - 12.7        | 0.499                       |
| Cataract      | 2.42 ± 1.47               | 2.1 (1.1, 3.4)               | 0.1 - 6.3         |                             |
**Discussion**

In recent years, positive effects of cataract surgery on IOP reduction in both glaucoma and nonglaucomatous patients have been established. Since the goal of glaucoma treatment is to achieve target IOP, low enough to stop the progression of glaucoma, there is a growing interest in studies on the effects of cataract surgery on IOP. This is understandable, bearing in mind that antihypertensive drugs often cause numerous and serious systemic and/or local side effects, that the effect of laser trabeculoplasty is diminished in time, and that filtration surgeries carry an increased risk of intraoperative and postoperative complications such as early and late hypotension, hypertension, bleeding, inflammation, accelerated cataract formation, and need for reoperation.

As a biological phenomenon, intraocular pressure is not a fixed value, but fluctuates over a 24-hour cycle and from one visit to another [17]. Parameters such as average and maximum IOP (peak) show significant short-term and long-term fluctuations, and therefore single IOP measurement during so-called office hours is insufficient to characterize the IOP profile of patients with glaucoma [18].

Various extraocular and intraocular devices with integrated pressure sensors are designed in order to gather data on IOP fluctuations as accurate as possible. Due to the number of shortcomings, such as impracticality, discomfort, data presentation as well as high cost, these devices are not applicable in daily clinical practice and at present they remain only a research tool.

Some of the studies have found a strong correlation between IOP peaks in provocative water drinking test (WDT) and IOP diurnal peaks, suggesting WDT as a suitable alternative to 24-hour measurements of IOP [19, 20].

Diurnal IOP curve test is reliable when performed by an trained examiner, relatively inexpensive, but also impractical both for the examiner and the patient (several visits during the day or hospital admission) so it is rarely applied in everyday clinical practice [21].

There are still controversial data whether Av. IOP, Max.IOP, short-term or long-term IOP fluctuations, are the most reliable and consistent predictors of glaucoma. Different sample sizes, inclusion-exclusion criteria, lack of a standard IOP fluctuation definition, IOP measurement time, study design, and duration of study are just some of the reasons for the controversies.

Our research examined the effect of PHACO on the abovementioned IOP parameters.

We found that cataract surgery resulted in a significant decrease in both MeanIOP and Max.IOP in both groups in the first month following surgery, with a further downward trend (Tables 1 and 2).

| Group                | MeanIOP Pre | Max.IOP Pre | MeanIOP Post | Max.IOP Post |
|----------------------|-------------|-------------|--------------|--------------|
| POAG + Cataract      | 20.3 ± 2.4  | 23.5 ± 3.2  | 18.5 ± 2.1   | 21.7 ± 3.3   |
| POAG                 | 21.0 ± 2.8  | 24.2 ± 3.5  | 19.5 ± 2.2   | 22.7 ± 3.4   |

At 6 months postoperatively, the mean value of Max.IOP in POAG patients was reduced by -3.16 ± 2.19 mmHg (-16.81%) compared to baseline, and in the control group by -2.53 ± 1.70 mmHg (-15.83%) (Table 1).

The obtained postoperative reductions are consistent with the results of other studies. Chen et al. found a postoperative IOP drop by -2.3 mmHg (range -1.1 mmHg to -4.0 mmHg), that is, -13% (range -7% to -22%) [9]. The study by Armstrong et al. found postoperative IOP drops by 12%, 14%, 15% and 9% after 6, 12, 24 and 36 months of follow-up, respectively [22].

According to our knowledge, previous studies on this issue analyzed the preoperative and postoperative IOP readings recorded on the basis of one measurement during the visit and values of the Av.IOP and Max.IOP, considering the fact that derivatives of the IOP daily curve were not available. Therefore, according to our knowledge, there are no available data to be compared with our research results, making this research unique.

Studies have found that the range of postoperative IOP reduction in non-glaucomatous subjects ranged from 1.5 mmHg to 3.5 mmHg, which is consistent with our results (Table 1) [7, 11].

The significance of large daily fluctuations and the determination of IOP peaks as factors associated with the glaucoma progression were also indicated by Asrani et al. who, with seemingly compensated 105 POAG eyes with an average IOP of 17.6 ± 3.2 mmHg, found a fluctuation of 10.0 ± 2.9 mm Hg when IOP was measured 5 times daily [23]. Barakana et al., in a 24-hour study including 32 patients, demonstrated that peak IOP was recorded outside of office hours in at least 1 eye in 69% of patients with POAG, resulting in immediate treatment change in 36% of eyes [24]. Jiang et al. investigated Max.IOP, standard deviation of IOP, range of IOP and mean IOP as predictors of glaucoma in 3,666 subjects during a 4-year follow up and identified Max.IOP as the most consistent parameter [25].

We also found Max.IOP to be a more clinically important parameter than Av.IOP, whereas the postoperative Max.IOP reduction was in correlation with preoperative IOP, concluding that patients with a higher baseline IOP experienced greater postoperative IOP reduction (Graph 1), which is in line with other studies that investigated the correlation between preoperative and postoperative IOP reduction [10, 11, 15].

In the POAG + Cataract group, the greatest reduction of -8 mmHg (-42.11%), with a preoperative Max. IOP of 19 mmHg, was observed in one patient (Graph 2). Based on this data, there is a need for additional research on the identification of patients with a high response, where there is a chance to achieve an adequate IOP reduction by PHACO.

In our study, POAG patients had the greatest short-term fluctuations preoperatively, 3.35 ± 1.68 mmHg
(Table 1) and a significant IOP reduction in relation to baseline occurred at the 3rd and 6th postoperative months (Table 2).

The goals of our study are similar to the study of Saccà et al., who analyzed diurnal IOP curve data preoperatively and at the 1st and 6th months postoperatively in 57 non-glaucomatous and 51 POAG patients. Phacoemulsification was performed in 13 non-glaucomatous and 15 POAG patients. The rest of the patients were operated by other techniques. Six months after PHACO, IOP has reduced by – 3.03 mmHg in non-glaucomatous patients, and by –4.39 mmHg in POAG patients. In POAG group, postoperative reduction by -3.33 mmHg in daily fluctuation occurred 6 months after surgery in comparison to preoperative values [26].

Reduction of short-term IOP fluctuations by -1.04 ± 2.20 mmHg (-30.74%) after 6 months in relation to the baseline, that we found, is not in agreement with Saccà’s result, and one of the possible explanations is the sample size, our sample being larger by 51.61% (16 patients).

In order to assess effects of cataract surgery on long-term (monthly) fluctuations of IOP, preoperative data on long-term (monthly) fluctuations are needed as well. Lacking this information, our results on postoperative long-term fluctuations showed that they are uniform among the groups and relatively at low-range for the Av.IOP and Max.IOP (Table 3). We also noted that in the POAG + Cataract group there were individuals with long-term fluctuations exceeding the desired low ranges and reaching 11.4 mmHg for Av.IOP and 12.7 mmHg for Max.IOP. This was not the case in the Cataract group in which the highest value of long-term fluctuation was 6.3 mmHg for the Max.IOP.

There are some limitations to this research: patients were not divided into groups according to preoperative IOP (e.g.: 9 – 14; 15 – 20; ≥ 21 mmHg) in order to examine the relation with postoperative reduction of IOP more accurately; no groups were formed based on glaucoma stage to determine the correlation between postoperative IOP reduction and stage of the disease; we did not have data on preoperative long-term IOP fluctuations.

Conclusion

Cataract surgery statistically significantly reduces both average and maximum intraocular pressure in patients with primary open-angle glaucoma and in non-glaucomatous patients. In primary open-angle glaucoma patients, a significant reduction in short-term intraocular pressure fluctuations was found three months after surgery and it retained six months after surgery. Long-term postoperative intraocular pressure fluctuations are short on average in primary open-angle glaucoma and in non-glaucomatous patients. The diurnal intraocular pressure curve is impractical to perform, but thanks to that procedure it is possible to identify patients in whom a clinically significant intraocular pressure reduction was achieved after surgery, which can lead to a reduction in the number of antiglaucoma medications or to exclude further filtration surgery if previously considered.

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