Refractive stability following uneventful small incision cataract surgery at week one

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Article History
Received: 14 April 2020
Reviewed: 15/April/2020 to 18/May/2020
Accepted: 19 May 2020
E-publication: 25 May 2020
P-Publication: July - August 2020

Citation
Hebah Joharjy, Catalina David, Pierre-Jean Pisella, Malek Slim, Jean Marie Baudet, Tiphanie Pichard. Refractive stability following uneventful small incision cataract surgery at week one. Medical Science, 2020, 24(104), 2052-2058

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ABSTRACT
Introduction: Small incision cataract surgery with foldable intraocular lens implantation is the most common surgery performed in France, leading to rapid improvement in visual acuity and early postoperative (Postop) refractive stability. Aim: To evaluate refractive and visual stability one-week post-surgery in order to establish the best time frame for lens prescription. Methods: This is a retrospective study that included patients who underwent uncomplicated small incision cataract surgery under topical anesthesia and single piece, monofocal intraocular lenses (IOL) implantation. Surgeries were performed in the Ophthalmology Department of the Jacques Coeur Hospital, Bourges, France, between November 2016 and June 2017. Refraction and best-corrected visual acuity were recorded at preoperative (Preop) and Postop (1-week and 3-8 weeks) examination. Statistical analysis was performed using the paired Student’s t-test. Results: A total number of 80 eyes of 73 patients aged between 50 and 96 were included in the study, out of whom 30 (41.1%) were male and 43 (58.9%) were female. Forty-two (57.5%) of patients had no comorbidities. Our study finds no statistically significant difference when comparing spherical refraction, cylindrical refraction, and visual acuity between the 1-week
Postop check-up and the 3-8 weeks Postop check-up. Conclusion: Spherical refraction, cylindrical refraction, and visual acuity are stable at 1-week post-cataract surgery. Therefore, lenses can be prescribed a week after cataract surgery.

Keywords: Refractive stability, cataract surgery, spherical refraction, cylindrical refraction, visual acuity.

1. INTRODUCTION
Cataract is one of the leading causes of decreased vision and blindness worldwide. In fact, the World Health Organization (WHO) estimates that it is currently responsible for 51% of bilateral blindness around the world, thus accounting for approximately 20 million people. While the number of individuals affected by this condition is in a continuous rise due to population growth, longer life expectancy and increased accessibility to medical care (and thus, lower diagnostic thresholds), the lack of a preventive or medical treatment leaves cataract surgery as the only viable option to restore vision (Prokofyeva et al., 2013). Cataract surgery not only improves vision and quality of life (Lamoureux et al., 2011) but has also been linked to numerous additional benefits, such as: decreasing the risk of developing fractures (Tseng et al., 2012) or being involved in car accidents (Owsley et al., 2002) and improving household economic status (Finger et al., 2012). Despite the fact that this surgery has radically transformed the visual prognosis of affected patients, important disparities still exist when analyzing the cataract surgical rate (number of cataract surgeries per 1,000 inhabitants per year) of different regions of the world. Moreover, this fact is still valid when analyzing different countries of the European Union (EU). According to Eurostat, in 2016, some countries had a lower cataract surgical rate (CSR), of under 5 per 1,000 inhabitants (for ex. Serbia and Romania), while some others had a CSR higher than 10 per 1,000 inhabitants (ex. France and Belgium) (de Peretti et al., 2018).

In France, one of the higher income countries in Europe, cataract surgery is the most common surgical procedure performed overall, with more than 800,000 surgeries annually (de Peretti et al., 2018). Advances in surgical techniques, including switching to topical anesthesia, large scale introducing of small incision cataract surgery (SICS), phacoemulsification and foldable intraocular lenses (IOL), reducing surgery duration as well as achieving higher success rates and lower complication rates, achieving better refractive outcomes and switching to outpatient surgery have led to an increase by more than 39% in the number of cataract surgeries performed between 2008 and 2016 (de Peretti et al., 2018).

In France, more than 92% of cataract surgeries are being performed as outpatient surgeries (de Peretti et al., 2018), allowing patients to return to their routine activities shortly after that. Consequently, patients’ expectations regarding postoperative (Postop) visual acuity gain and recovery time have also increased. Although there are different time frames for lens prescription following cataract surgery (some depend on the doctor’s experience, others on classic guidelines), the vast majority of patients do not receive lens prescriptions until 1 month post-cataract surgery in order to ensure refractive stability. A smaller interval between surgery and lens prescription would be beneficial for patients in order to resume normal life as quickly as possible. More and more studies are proposing that the classic one-month interval might be outdated, given recent advances in surgical techniques (De Juan et al., 2013; Mc Namara et al., 2019).

The purpose of our study is to evaluate whether refractive stability is obtained one week after non-complicated cataract surgery in order to safely provide lens prescription at this threshold.

2. MATERIALS AND METHODS
Patients and inclusion criteria
The current retrospective study included 80 eyes of 73 patients aged between 50 and 96, who underwent uncomplicated cataract surgery under topical anesthesia and a single piece, monofocal IOL implantation in the capsular bag between November 2016 and June 2017 in the Ophthalmology Department of the Jacques Coeur Hospital, Bourges.

Exclusion criteria
Patients presented with the previous history of eye surgery, corneal disease, ocular inflammatory disease, or any retinal pathology that might interfere with accurate refraction evaluation; patients who had intra- or Postop complications; those who benefited from multifocal or toric IOL implantation; pediatric patients; subjects who underwent surgery by general anesthesia or subten on block.

Ethical approval
The current study followed the tenets of the declaration of Helsinki for research involving humans, where the ethical approval was obtained from the Health Research and Ethics Committee at Jacques Coeur Hospital, Bourges, France (ETC-JC-0031).
Patients' recorded data
The following data were collected: age, sex, prior ocular and systemic medical history, automated and subjective refraction and best-corrected visual acuity preoperatively (Preop) and Postop (1-week and 3-8 weeks).

Preoperative (Preop) examination
The Preop examination consisted of objective (using NIDEK ARK-500A) and subjective assessment of refraction, best-corrected visual acuity (using a LogMAR chart), intraocular pressure, slit-lamp examination, dilated fundus examination and ocular coherence tomography (Heidelberg Spectralis). Zeiss IOL Master 500 was used for the Preop optical coherence biometry measurement of keratometry, axial length and anterior chamber depth in all patients, while the value in diopters of the IOL was chosen using the SRK/T formula.

Surgery
All surgeries were performed using the same technique (Divide and Conquer) by one of our two very experienced surgeons using topical anesthesia (Tetracaine 1%, Oxybuprocaine 1.6 mg/0.4 mL, Visthesia 1.5%). The two incisions were performed using a 2.2mm ophthalmic knife with the side port at the 1 o’clock position and the main incision at the 11 o’clock position. Then cohesive ophthalmic viscosurgical device (OVD) was injected intracameral (Visthesia 1.5%). Capsulorhexis was performed using the cystotome technique, then hydrodissection, followed by phacoemulsification and one-handed irrigation/aspiration using the Bausch and Lomb - Stellaris PC. The monofocal IOL (Bauch+Lomb© EyeCee® One or PodEye (PhysIOL)) was inserted into the capsular bag under viscoelastic protection, followed by viscoelastic aspiration with the one-handed irrigation/aspiration piece. Incisions were hydrated, and 1mg of cefuroxime was injected intracameral. Topical antibiotic and steroid anti-inflammatory ointment was applied. Postop treatment consisted in one week of local tobramycin and dexamethasone and one month of local indomethacin.

Postoperative (Postop) examinations
Patients were later examined 1-week Postop, defined as 6 to 11 days post-cataract surgery, and 3-8 weeks Postop, defined as 20 to 60 days post-cataract surgery. The routine examination consisted of both objective and subjective refraction, best-corrected visual acuity (LogMAR), intraocular pressure, slit-lamp examination, and fundus examination.

Statistical analysis
Data (including both demographic and clinical indices) was collected into an Excel sheet using Microsoft Excel 2013 (Microsoft Corporation). Data management was performed using Microsoft Excel, and then transferred to GraphPad Software, Inc. for analysis. Descriptive analysis was conducted: categorical data were expressed as number and percentage; continuous variables were expressed as mean ± standard deviation and range (minimum: maximum). Inferential analysis was performed according to the analysis plan where paired Student’s t-test was used to compare Preop to Postop data as well as between the two Postop follow-ups. Confidence intervals were set at 95% where a p-value ≤ 0.05 was used as an indicator for detecting a statistically significant difference between paired readings.

3. RESULTS
Demographic and clinical characteristics of the study population
80 eyes of 73 patients were recruited in the current study. Of this number, 30 (41.1%) were male, and 43 (58.9%) were female. The age range was 50 - 96 (77.7 ± 8.7). There were 51 right eyes (63.8%) and 29 left eyes (36.2%). Forty-two (57.5%) of patients had no comorbidities. However, 13 (17.8%) had diabetes mellitus, 13 (17.8%) had arterial hypertension, 4 (5.47%) had hyperlipidemia, 3 (4.1%) had glaucoma, 2 (2.73%) had coronary artery bypass graft, 1 (1.36%) had obstructive sleep apnea, 1 (1.36%) had Alzheimer’s disease, and 1 (1.36%) had hypothyroidism. Subject characteristics including age, sex, and associated diseases on the date of surgery are seen in Table 1.

Spherical refraction evolution
Comparing pre- (0.86 ± 2.37 D) to post-operative (0.01 ± 0.46 D, and 0.06 ± 0.44 D, at 1 week and 3-8 weeks, respectively) spherical refraction, a statistically significant decrease in hypermetropia was observed (p = 0.0015, and 0.0026, respectively) over the entire study period (Table 2 & Fig. 1).

Meanwhile, there was no statistically significant change (p = 0.0808) in mean automated spherical refraction when comparing 1-week Postop to 3-8 weeks Postop values (Table 2 and Fig. 1).
Table 1  Demographic and clinical characteristics of the study subjects.

<table>
<thead>
<tr>
<th>Character</th>
<th>Patients (n=73)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes (n)</td>
<td>80</td>
</tr>
<tr>
<td>Right eyes (n; %)</td>
<td>51 (63.8%)</td>
</tr>
<tr>
<td>Left eyes (n; %)</td>
<td>29 (36.2%)</td>
</tr>
<tr>
<td>Age (Y)</td>
<td>77.7 ± 8.7</td>
</tr>
<tr>
<td>Min : Max</td>
<td>50 - 96</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male (n; %)</td>
<td>30 (41.1%)</td>
</tr>
<tr>
<td>Female (n; %)</td>
<td>43 (58.9%)</td>
</tr>
<tr>
<td>Disease Free (n; %)</td>
<td>42 (57.5)</td>
</tr>
<tr>
<td>Comorbid Diseases (n; %)</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>31 (42.5%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>13 (17.8%)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>13 (17.8%)</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>4 (5.5%)</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>3 (4.1%)</td>
</tr>
<tr>
<td>Coronary artery bypass graft</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td></td>
<td>2 (2.7%)</td>
</tr>
</tbody>
</table>

Results are presented as mean ± standard deviation, Min to Max values, number (n), and percent (%).

Table 2  Automated spherical refraction, cylindrical refraction, and visual acuity at Preop, 1-week Postop, and 3-8 weeks Postop.

<table>
<thead>
<tr>
<th></th>
<th>Spherical refraction (D)</th>
<th>Cylindrical refraction (D)</th>
<th>Visual acuity (LogMAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Min:Max</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Preop</td>
<td>0.86 ± 2.37</td>
<td>-10.0:4.25</td>
<td>-0.93 ± 0.62</td>
</tr>
<tr>
<td>Postop (1-Week)</td>
<td>0.01 ± 0.46 a</td>
<td>-1.25:1.50</td>
<td>-0.73 ± 0.49 a</td>
</tr>
<tr>
<td>Postop (3-8 Weeks)</td>
<td>0.06 ± 0.44 a</td>
<td>-1.25:1.25</td>
<td>-0.70 ± 0.46 a</td>
</tr>
</tbody>
</table>

Results are presented as mean ± standard deviation and Min to Max values.

aStatistically significant compared to Preop data (p ≤ 0.05)

Figure 1  Automated spherical refraction (D, diopters) at Preop, 1-week Postop, and 3-8 weeks Postop.

Results are presented as Whisker: Min to Max plot. Each box includes the mean value, falling between the 25th and 75th percentiles. The median value is represented as a horizontal line inside each box.
Cylindrical refraction evolution
Comparing pre-(-0.93 ± 0.62 D) to post-operative (-0.73 ± 0.49 D, and 0.70 ± 0.46 D, at 1-week and 3-8 weeks, respectively) cylindrical refraction, a statistically significant (\(p = 0.0055\), and 0.0013, respectively) decrease in the degree of astigmatism was observed over the entire study period (Table 1 and Fig. 2).

There was no statistically significant shift (\(p = 0.3964\)) in mean automated cylindrical refraction (\(p = 0.3964\)) when comparing 1-week Postop to 3-8 weeks Postop values (Table 2 and Fig. 2).

![Figure 2 Cylindrical refraction (D, diopters) at Preop, 1-week Postop and 3-8 weeks Postop. Results are presented as Whisker: Min to Max plot. Each box includes the mean value, falling between the 25th and 75th percentiles. The median value is represented as a horizontal line inside each box.](image)

Visual acuity (LogMAR) evolution
Comparing pre-(0.30 ± 0.14) to post-operative(0.03 ± 0.05, and -0.02 ± 0.04, at 1 week and 3-8 weeks, respectively) visual acuity showed a statistically significant (\(p < 0.0001\)) improvement over the entire study period (Table 1 & Fig. 3).

Meanwhile, comparing the two Postop assessments clarified that there were no statistically significant changes in visual acuity (\(p = 0.0734\)) between 1-week Postop and 3-8 weeks Postop (Table 2 & Fig. 3).

![Figure 3 Visual acuity (LogMAR) at Preop, 1-week Postop, and 3-8 weeks Postop. Results are presented as Whisker: Min to Max plot. Each box includes the mean value, falling between the 25th and 75th percentiles. The median value is represented as a horizontal line inside each box.](image)

4. DISCUSSION
Cataract surgery aims to restore clear vision as quickly as possible. This study aimed to find out if refractive stability is achieved 1-week after uncomplicated cataract surgery (UCCS). The results of our study showed that automated refraction (spherical refraction and cylinder refraction), as well as visual acuity (LogMAR), were all stable at 1-week Postop compared to 3-8 weeks Postop. Findings from our study are consistent with the results of a previous study (De Juan et al., 2013), which indicated that automated refraction (both spherical and cylindrical) was constant 1-week after uneventful cataract surgery. In addition, a recent study reported that both
spherical refraction and spherical equivalent were stable 1-week post UCCS (Ostri et al., 2018). Contrary to our findings, the results of Ostri et al. (Ostri et al., 2018) showed that cylindrical refraction was not stable 1-week post-UCCS. It is possible that this difference is attributed to the fact that our study used the negative notation of cylindrical value while Ostri et al. (Ostri et al., 2018) relied on both positive and negative cylindrical values in its statistics. Moreover, in the study of Ostri et al. (Ostri et al., 2018), patients were operated by three different surgeons, and this may lead to a different extent of incision induced corneal astigmatism.

Another study has also proposed that there is no reason to follow-up patients further than two weeks post UCCS, as both the spherical and cylindrical refraction were stabilized after one week in 63% of patients and after two weeks in the remaining 37% (Lake et al., 2005). Furthermore, Sugar et al. (Sugar et al., 2001) also concluded that refraction became stable one week after phacoemulsification with foldable acrylic intraocular lens implantation. Many authors consider that applying current techniques (topical anesthesia, small incision cataract surgery, with minimal incision induced corneal astigmatism, phacoemulsification, with foldable IOL implantation) may enable faster stabilization of refraction at 2-weeks Postop thus allowing safe lens prescription at this time, rather than the commonly adopted practice of prescribing lens at 1 month Postop (McNamara et al., 2019; Claoue and Hicks, 1996; Lee, 2013; Wei et al., 2012).

Based on our study’s and similar studies’ results, it is safe to conclude that refraction stability occurs within one week following the SICS, safely allowing lens prescription at this threshold (Ostri et al., 2018; Lake et al., 2005; Sugar et al., 2001). Early lens prescription is beneficial for reducing anisometropia and recovering near and intermediate vision (which ameliorates ocular comfort and allows patients to perform everyday tasks) (Sugar et al., 2001). Many studies have applied the spherical equivalent as an outcome indicator. This is an estimate of the spherocylindrical refraction and cannot distinguish between spherical and cylindrical errors and can induce inaccurate and unwanted consequences. Spherical equivalent was used to simplify the interpretation of refractive errors (Aristodemou et al., 2019). Hence, in our study, we separated the components of refraction into elementary independent components represented by sphere and cylinder. We consider that this segregation will make our interpretation more accurate and less confusing since different refractions can have the same spherical equivalent (De Juan et al., 2013; McNamara et al., 2019).

5. CONCLUSION

Our study shows refractive and visual stability following uneventful SICS surgery at week one Postop. This confirms that using current technology, it is safe to establish a single, Postop check-up, one week after SICS and provide lens prescription at this time. This would, in turn, have a positive impact on both health systems (by decreasing the number of unnecessary check-ups) and patients’ quality of life (by reducing visual recovery time and stress levels).

List of abbreviations

WHO: World Health Organization; EU: European Union; CSR: Cataract surgical rate; SICS: Small incision cataract surgery; UCCS: Uncomplicated cataract surgery. IOL: Intraocular lenses; LogMAR: Logarithmic of the minimum angle of resolution; OVD: Ophthalmic viscosurgical device; OCT: Optical coherence tomography; Preop: Preoperative; Postop: Postoperative.

Conflict of interest

There is no conflict of interest to be reported.

Financial resources

The authors have not received of any financial support for the current study.

Study limitations

The current study suffered a number of limitations such as being a retrospective study, which did not permit collecting more detailed indicators when needed. The relatively small number of included patients may also increase the margin of error.

REFERENCE

3. De Juan V, Herreras JM, Pérez I, Morejón Á, Cristóbal ARS, Martín R, Fernández I, Rodríguez G. Refractive stabilization