JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ASSESSMENT OF THE REFRACTIVE ERROR AND STABILISATION OF REFRACTION AFTER CATARACT SURGERY IN RELATION TO THE LENGTH OF THE EYEBALL

Jewel Namasudra[1], Dr. Amar Kanti Chakma[2]

[1]Research Scholar, OPJS University, Churu Rajasthan
[2]Professor and H.O.D, OPJS University, Churu Rajasthan

ABSTRACT

There is mounting evidence that after tiny incision cataract surgery, refractive stability occurs soon. Still, many standards recommend waiting anywhere from four to six weeks before doling out the glasses. This research aimed to fill a gap in the current literature on refractive stabilization by assessing a variety of factors that might make doctors reluctant to correct refractive error in the immediate post-operative period following standard cataract extractions. Intraocular lenses manufactured by Bausch and Rayner were utilised. Ninety-one percent of emmetropic patients, seventy-seven percent of myopic patients, and forty-six percent of hypermetropic patients reached refractive stability by week three. Optical biometry and the Barrett Universal II algorithm for calculating lens implant power were used to correct postoperative refraction. There was no discernible variation between separate test series when comparing the spherical analogue. After the first postoperative day, there was no statistically significant change in any of the measures taken at any of the follow-up appointments; nevertheless, the cylinder power was substantially greater on that day compared to all subsequent sessions. Spherical equivalent discrepancies between one post-operative measurement and the reference measurement had 95% confidence intervals ranging from around 2.00 D on the first post-operative day to between 1.20 D and 0.80 D in weeks 1, 3, and 5. On day one after surgery, the cylinder power confidence interval was 2.00 D, whereas in weeks 1-3 it was 1.27 D, and in weeks 4-5 it was 0.88 D. It was shown that the statistical dispersion of both the spherical equivalent and the cylinder power decreased somewhat as recovery time following surgery increased. Our study found that the measurement error for spherical equivalent using automated refractometry in ageing phakic eyes is 0.80 D, while the error for cylinder power is 1.16 D.

Keywords:- Cataract, postoperative refraction, refraction measurement, repeated automated refractometry, Corneal Tunnel

INTRODUCTION

Myopia, hyperopia, and astigmatism may all be permanently corrected with cataract surgery, making it the only permanent solution for cataract-related blurry vision. In order to effectively manage the resulting change in refractive status of the eye, the best intraocular lens for each individual patient is determined through meticulous preoperative planning, which takes into account a wide range of factors, including axial length of the eye, corneal topography and keratometry, patient preferences, and more. Many patients who have an artificial intraocular lens (IOL) installed still need post-operative refractive correction, either for close or distant viewing, which may delay their return to driving and other activities requiring distance vision. Some standards advise waiting four to six weeks after a large-incision cataract treatment before attempting refractive correction. This is because of the possibility for extensive post-operative healing.

However, new research suggests that refractive stability may be achieved much more quickly with minor incision approaches. Ametropia is connected with decreased quality of life, thus it's important to pinpoint the exact time after surgery when patients can obtain correction without running the risk of additional refractive alterations. It has also been shown that individuals who have sequential cataract surgeries benefit more from definitive post-operative refractive error examinations. Modern intraocular lens (IOL) innovations like RxSight's RxLAL light-adjustable lens make post-operative refractive correction a real option. These adjustments, however, can only be performed once a final, stable refractive measurement has been recorded after surgical correction. Therefore, ophthalmological surgeons can deliver better results for patients without making them wait for long periods of time between surgeries or delaying their return to emmetropic correction, thanks to increased trust in early post-operative refractive results. This research was done to fill a gap in the literature about how long it takes for refractive stability to be reached after small-incision phacoemulsification cataract surgery. In addition to measuring the cylinder, we also measured the visual acuity, central corneal thickness, and effective lens position to see whether any of these factors were related to refractive instability (ELP). If these results are in line with previous publications on post-operative stabilisation, they will contribute unique data on factors connected with refractive stability and lend further support to the practise of early treatment of refractive defect after this common surgical method.

LITERATURE REVIEW

Małgorzata Mrugacz (2022) The purpose of this study was to assess the stability of refraction after phacoemulsification-assisted cataract surgery by examining the refraction changes in individuals according to eyeball length. Ninety participants, ranging in age from 46 to 85 years old, were split into three groups: emmetropic, hypermetropic, and myopic. Intraocular lenses manufactured by Bausch and Rayner were utilised. Ninety-one percent of emmetropic patients, seventy-seven percent of myopic patients, and forty-six percent of hypermetropic patients reached refractive stability by week three. The lens implant power was calculated using optical biometry and the Barrett Universal II formula, achieving the target postoperative refraction.

Philomena McNamara (2019) Eyeglasses are often prescribed to patients following cataract surgery, and waiting to do so may have unfavourable effects on their quality of life. The study's goal is to confirm the refractive stabilisation time in an Australian population and to provide a practical time frame for corrective lenses. A total of 102 participants (51 females and 35 males) were enlisted the day following successful unilateral cataract surgery with a monotonal intraocular lens. At 2, 4, and 6 weeks after surgery, the central corneal thickness, subjective refraction, and automated refraction were all measured. At two and four weeks, we collected data using a brief questionnaire to determine how much of a disruption in daily life uncorrected near vision was causing. Over the course of the six-week study, Average automated or subjective spherical equivalent refraction, corneal thickness, uncorrected distance visual acuity, and close visual acuity all remained stable. By week four, 75% of patients said that they were hampered "somewhat" or "a lot" by their uncorrected near vision, up from 59% at week two. Most participants' daily lives were negatively impacted by their inability to see near objects clearly without corrective lenses. Two weeks after surgery, there was no change in any of the eye's measurable properties. For patients who have had straightforward unilateral cataract surgery, this is the absolute longest period of time during which they will need to wait for their spectacle prescription to be filled.

Emily Charlesworth (2020) In order to determine when refraction is stable after routine cataract surgery involving the implantation of monotonal intraocular lenses, we conducted a systematic evaluation of the literature. The standard recommendation is to get new glasses around four to six weeks after surgery. We hypothesized that, as surgical procedures improved, refractive stability would be reached at an earlier time, which would have significant immediate effects on patients' quality of life. After selecting appropriate keywords, we searched Medline, CINAHL, AMED, Embase, Web of Science, and the Cochrane Library for studies that evaluated postoperative refraction after routine cataract extraction. All included papers' citation histories and reference lists were combed through. Energy was utilized to find unpublished works (www.opengrey.eu). Studies were included in the study if they assessed refraction at certain time points after surgery. There were found to be 6,680 papers in the search. Two reviewers independently assessed the abstracts, and nine fulfilled the inclusion criteria; five were included in the meta-analysis. The overall quality of the publications was evaluated using the Methodological Index for Non-Randomized Studies (MINORS). Data from 301 people were analysed using a meta-analysis of spherical, cylindrical, and spherical equivalent rectifications in Review Manager 5. For either spherical or cylindrical data, or their spherical equivalents, there was no statistically significant difference between 1-week and 4-week refraction. All refractive elements showed negligible heterogeneity (I2 25%). Results at 2 and 4 weeks after surgery were comparable. There were a few people in the study whose cylinder adjustments were extremely unstable a week after surgery, according to the data collected. There was no statistically significant difference between the spherical, cylindrical, and spherical equivalent values at 1- and 4-weeks following cataract surgery. That means new glasses might be delivered in 7 days after surgery. Among the recently collected data set, 7% of patients showed very unstable cylindrical modifications after only 1 week. This phenomenon has been seen, and identifying such patients has been the subject of much study, but more work is needed.

Christoffer Ostri |(2018) In order to evaluate the effectiveness of automated refraction one week and one month after routine cataract removal. This prospective cohort study included patients over the course of 2 months, all of whom were scheduled for bilateral small-incision phacoemulsification cataract surgery. Conditions that might lead to an inaccurate automated refraction estimate, such as corneal and/or retinal disease, and consequences from surgery, were not included in the study. In this study, automated refraction measurements were obtained one week and one month following surgery. Ninety-five people who met the inclusion and exclusion criteria were tracked for the whole course of the trial. There was no statistically significant change in spherical equivalent refractive error after one month after surgery. There was no correlation between the degree of myopic or hyperopic refractive shift and factors such as age, preoperative corneal astigmatism, axial length, or the quantity of energy used during phacoemulsification. Twelve percent of patients had a refractive error of 1.0 D or higher. The mean refractive shift in spherical equivalent for this group was 0.49 D between 1 week and 1 month post-surgery, which was close to statistical significance. There were no statistically significant differences between the phacoemulsification patients and the others in terms of age, preoperative corneal astigmatism, axial length, or phacoemulsification energy. Automated refraction is constant one week after standard cataract extraction, although there is a tendency toward instability if the refractive goal is missed by more than 1.0 diopter.

Thomas A. Berk, MD (2018) When it comes to corneal incision, capsulorhexis creation, and nuclear fragmentation, femtosecond laser-assisted cataract surgery (FLACS) has recently emerged as a viable alternative to manual cataract surgery (MCS). The purpose of this research was to compare and contrast the refractive and visual outcomes of MCS and FLACS in previously untreated eyes. Data from a single location is used for many analyses that are compared and contrasted throughout time. consecutively treated eyes at a single tertiary care hospital between July 1, 2012 and July 31, 2015 who got both FLACS and MCS. Patient demographics, ocular history, preoperative measurements and biometry, and surgical results were analysed retrospectively using a generalised linear mixed model to account for changes in baseline variables and within-patient correlation. When the two-tailed P value was less than 0.05, statistical significance was assumed throughout the study. To what percentage of eyes does an AE of 0.5 or less apply? (D). Secondary goals included achieving UDVA of 20/20, 20/25, and 20/30 without corrective lenses. It was also determined whether proportion of eyes had a refractive error of 0.25 D or 1.0 D. We administered MCS to 883 and FLACS to 955 of the 1089 patients. With an adjusted odds ratio (OR) of 1.28 favouring FLACS, 82.6% of eyes treated with FLACS and 78.8% of eyes treated with MCS had AE of 0.5 D after 3 weeks. It was shown that the incidence of AE was similar across patients with FLACS and MCS, with 97.1% of FLACS patients and 97.2% of MCS patients reporting AE of 1.0 D and 49.3% of FLACS patients and 46.3% of MCS patients experiencing AE of 0.25 D, respectively. Factors that predicted a favourable refractive outcome were an axial length between 22 and 24.8 mm, tori intraocular lens implantation, low preoperative cylinder, and a high preoperative average keratometry. Patients who were treated either for distance (P = 0.30), close (P = 0.06), or distant (P = 0.66) did not substantially vary from one another in the proportion of those who achieved 20/20, 20/25, or 20/30 UDVA. No statistically significant difference could be seen between eyes treated with FLACS and eyes treated with MCS regarding refractive and visual outcomes after surgery.

Material and Methods

Participants ranged in age from 46 to 85 (representing 29 men and 61 women). A total of 71.63 years were represented in the sample population. All of them had cataracts brought on by advancing age, making them ideal candidates for phacoemulsification. The research excluded patients who had had vitrectomy with intra-operative or post-operative difficulties, those who had anterior segment issues, those who had myopia with severe central retinal modifications, and those with optic nerve illnesses. All of the participants in the research underwent phacoemulsification surgeries and had prosthetic lenses implanted. Intraocular lenses from Bausch & Lomb and Rayner were implanted surgically. C-flex lenses have two longer haptics on opposing sides, whereas the Acheros lens has four shorter ones. The various lenses were used to examine how the haptic number affected refractive errors following cataract extraction. These results were derived using Barrett's Universal Formula II. A LENSAR 900 instrument was utilized to assess corneal thickness, anterior chamber depth, and eyeball length. Pupil dilation was used in all of these examinations.

With the use of the simplified Gullstrand eye model, we can determine that the typical axial length of a human eyeball is about 24.4 mm. Based on the correlation between refractive error and axial length, we divided patients in our research into four categories: Group I included 30 participants with cataracts who had emmetropic vision and eye lengths between 22 and 24 millimeters. Thirty persons with cataracts and hypermetropic vision made up Group II. Thirty participants with cataracts and myopia made up Group III. Study enrollment is depicted in Figure 1 of the consort flow diagram.

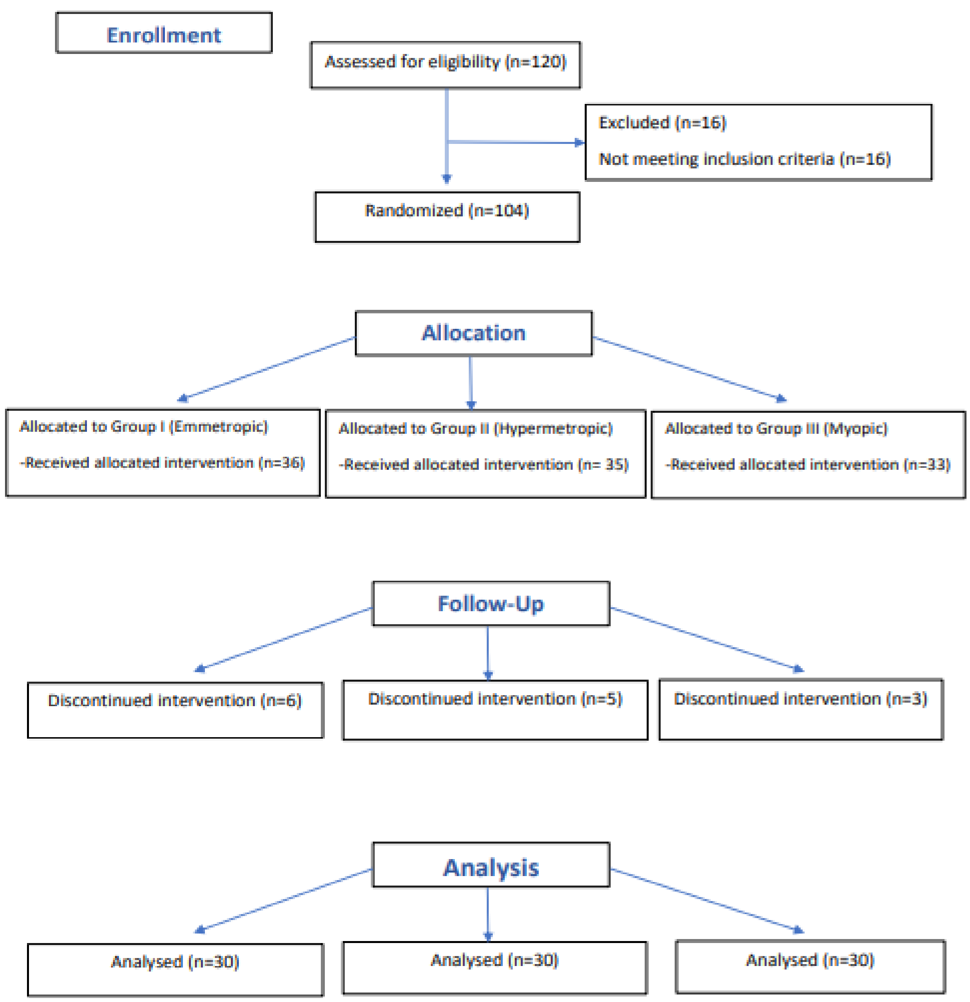

Figure 1. Consort flow diagram of the study

Prior to the treatment, at one week and one month postoperatively, all patients underwent a comprehensive ophthalmological evaluation. With the best feasible glasses correction, the patient's visual acuity (visus) was measured using Snellen charts at distances of 5 meters and 40 centimeters. Topcon auto ceratore fractometer tests were performed to determine objective refraction (KR-8800). The autorefractor took the average of the patient's third set of measurements. All of the study was approved by the bioethics committee at the Medical University of Bialystok, guaranteeing that it followed the guidelines established by the Helsinki Declaration.

Results

Final examinations are performed between weeks 7 and 8 post-op, and Figure 2 displays the range of SE and cylinder power values at that time. There is a clinically significant dispersion in both components of the refractive error, despite the fact that the SE and cylinder power are often very near to zero. The minus cylinder nomenclature used here puts all cylinder values in the negative range, yet the SE values cluster rather normally around zero. The cylinder is -7.75 D and the median SB is -3.37 D. Figure 3 shows the mean and standard deviation of the refraction values recorded at the several postoperative time periods minus the final examination result. Medians are near to zero across the board, however there is the most variation in the data on the day after surgery. Both datasets have some outlying values. Although they are likely to be minimal in most instances, they were included on purpose in the dataset since they closely correlate to what is anticipated in the everyday practise of cataract surgery. There is also a noticeable bias in the data, most notably for the measures recorded five weeks after surgery.

The standard error (SE) does not differ significantly ($p > 0.05$) over the five-measurement series used in the Friedman variance analysis for dependent samples. In contrast, there was a statistically significant variation in the cylinder values among the several sets of measurements (p 0.01). When comparing the same two groups, we find that the only time there is a significant difference is between the first day following surgery and all future follow-up visits. From week 1 to week 8 post-op, there is no statistically significant change ($p > 0.05$). In a similar fashion to Figure 3, Figure 4 displays the absolute values for the SE and the cylinder deviations. Both figures' medians and whiskers indicate that, after roughly a week following surgery, there is only a little difference between the first and last days of recovery and the succeeding weeks of recovery when compared to the ultimate refraction value. Table 1 displays 95% CIs for the difference between each refraction measurement and the reference value.

When there is a large discrepancy between two sets of data, a confidence interval may be calculated using the standard deviation of the difference. Despite the fact that it is not reasonable to presume that the values are normally distributed over any of the eight series of observed value differences, they are provided here for convenience and for comparison with another research. The final column displays confidence intervals for the difference between two successive test refraction readings in healthy people of a comparable age range. They approximate the measurement uncertainty of the autorefractor used in this work when applied to the process of evaluating the refractive power of ageing eyes.

The study's goal is to determine how long it takes for refraction to become stable after surgical intervention. If two refraction readings taken on separate days are statistically equivalent, and any discrepancy between them and a reference value can be attributed to methodological or physiological observational mistakes, then we conclude that refraction is sufficiently stable.

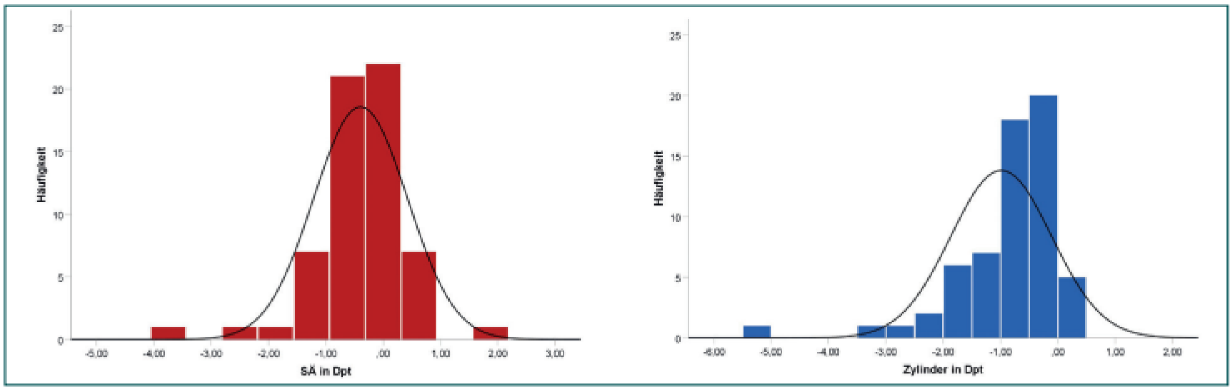

Figure 2: Distribution of the refraction values at the time of the final examination (n = 61).

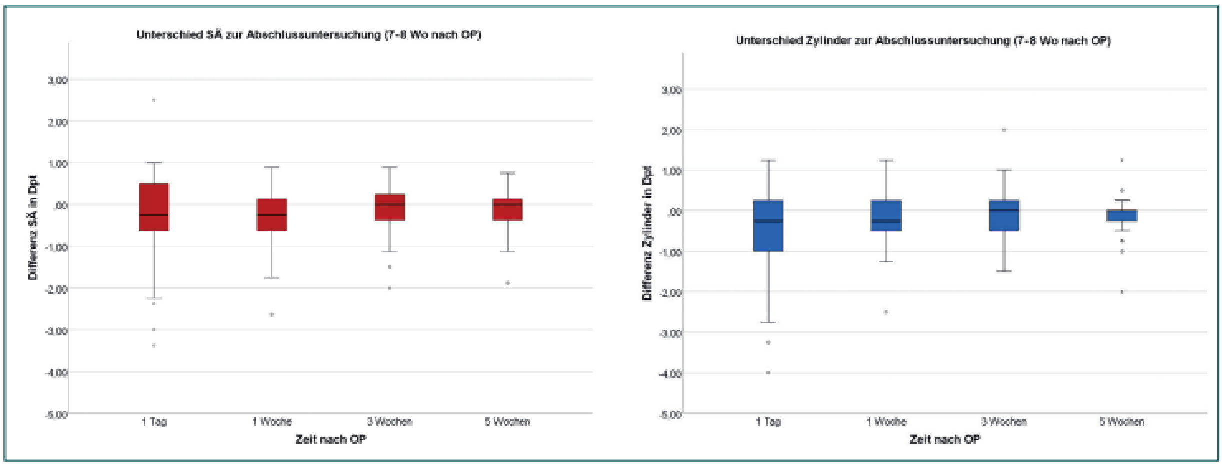

Figure 3: Difference between the values of the spherical equivalent (left) and cylinder (right) between different follow-up appointments and the final examination.

Using a box and whisker plot, we can see that the median is located in the middle of the two boxes and the two inner quartiles, while the range is shown by the two outside whiskers. Data points outside the box by more than 1.5 times the interquartile range are shown by circles. Data points that are greater than three times the interquartile range outside the box are denoted by an asterisk.

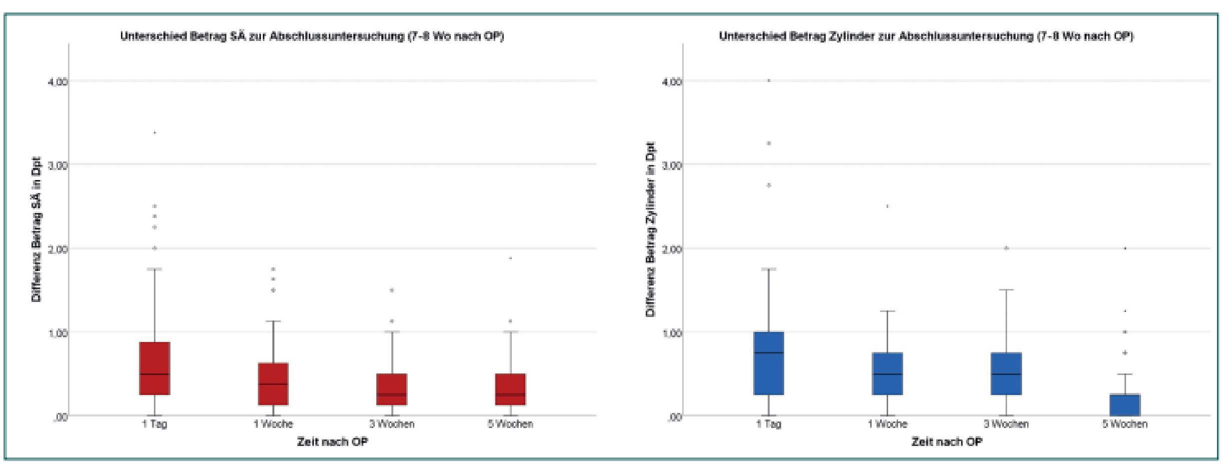

Figure 4: Difference between the absolute values of the spherical equivalent (left) and cylinder (right) between different follow-up appointments and the final examination, shown as absolute values.

Table 1: 95% confidence intervals for measured value differences between two repeated objective refraction measurements.

	1 day after surgery	1 weeks after surgery	3 weeks after surgery	5 weeks after surgery	Control
95% CI for SE (± 1.96 SD)	± 1.96 D	± 1.20 D	± 1.07 D	± 0.95 D	± 0.80 D
95% CI for cylinder (± 1.96 SD)	± 2.00 D	± 1.26 D	± 1.27 D	± 0.88 D	± 1.16 D

Figure 4 illustrates that there is a wide range of refraction readings near zero even eight weeks after surgery (the ideal value). The SE is not zero for a number of different reasons. One issue is that the refractive power of the IOL or the healing process can be calculated incorrectly because to measurement mistakes, rounding, or the use of inaccurate mathematical models. However, local variations in target refraction could possibly account for this discrepancy. Patients who presented moderate to severe myopia before to surgery often had a mild myopia as the goal refraction. The reasoning behind this is that the patient will benefit most from maintaining their normal visual preferences, in which they are able to see adjacent things more clearly than those farther away, following surgery. While the incision during cataract surgery can change the corneal astigmatism, it cannot neutralize the deviations from zero in the cylinder power. 5,13 Because all cylinder power values are reported as negatives and most eyes only showed mild postoperative astigmatism, we can deduce that the distribution of cylinder power values is skewed. The Friedman variance analysis demonstrates that there is no significant change (bias) in the SE, whereas there is a significant difference in the cylinder power only for the first day following surgery.

Because of this, After the surgery, we may assume that neither myopia or hyperopia will develop, but that astigmatism will worsen. The impact of the incision on postoperative corneal astigmatism5 is one possible explanation. Time following cataract surgery impacts refraction, as shown by the variation in SE and cylinder values provided in Figures 2 and 3, and the varied placements of the medians in Figure 4. While the spread and median positions are both larger immediately following the operation, they eventually return to pre-operation levels after about a week. Whether there's a discrepancy between two refraction readings, researchers want to know if it's due to the individuals' eyes changing over time or to some other reason, such measurement error or physiology, a closer study at the literature is required. It is common practice to report measurement errors for both SE and cylinder of 0.3 D to 0.4 D (95% confidence interval) when talking about automated refractometry in young, healthy eyes. Specifically, the method, the interval between measurements, and the sample population all affect the measurement error. Whether or not cycloplegic medicines are employed to quantify refractive error of the eye is also important, Automated refraction of younger eyes is extremely useful. As of 2018, there is a dearth of research on the extent to which older people with phakia or pseudophakia experience measurement errors. When conducting subjective refraction on phakic or pseudophakic eyes, for example, Leinonen et al. offer a measurement error of around 0.75 D for the SE and about 1.00 D for the cylinder, attributing the wider dispersion in older eyes to the, on average, poorer visual acuity in older eyes.

After multiple measurements with an autorefractor on eyes with pseudophakia, Reeves et al. report discrepancies in excess of a 0.50 D range in 25% of the eyes. However, unlike the current investigation, these numbers only correspond to a single measurement made after surgery. On the first postoperative day, the SE and cylinder measured value disparities are within a range of around 2.00 D, and it decreases dramatically from there for all future measures as shown in Table 1. If you look at the SE range over time, you can see that it gradually narrows as recovery time from surgery progresses. The predicted measurement uncertainty of the refractometer utilized in this investigation is slightly smaller than the range of the measurements from the fifth week after surgery. After the first three weeks following surgery, the cylinder power range is the same, and by week five, it has shrunk to below the projected measurement uncertainty. However, Please note that even for younger eyes three or four weeks after surgery, the ranges for both SE and cylinder are almost double what is indicated elsewhere. This also applies to the recognised refractometer measurement uncertainty with persons of a comparable age and otherwise healthy eyes.

The measurement uncertainty in SE and cylinder of older eyes is almost the same size, according to the This amount, however, was measured subjectively and hence is not directly comparable. Leinonen et al. speculated that the larger measurement uncertainty was due to the decreased visual acuity of several of the elderly patients. A common reason of inaccurate autorefractor readings is age-dependent miosis, which produces a 2 mm average decrease in pupil diameter in 70-year-olds compared to 20-year-olds. The accuracy of the Nidek autorefractor utilized here depends highly on pupil size, so it needs to be seen if other devices or methods for measuring refraction depend less on pupil size. As far as this research's goals are concerned, the deciding factor is the time at which the variation in the measured values can be considered to be minor or steady enough to be acceptable. Using the statistical spread depicted in Figures 2 and 3, as well as the intervals provided in Table 1, a reasonably steady refraction can be assumed roughly three weeks after surgery. It's also important to note that the variation in postoperative measurements is just little higher than normal, making it clinically acceptable. The findings given here lend credence to the suggestion of other writers that refraction measurements can be taken with sufficient accuracy as early as seven days or two weeks after surgery. On the other hand, However, other authors contend that the eye's refractive strength is not adequately stable until 90 days after surgery, therefore it might be claimed that waiting seven or eight weeks is not enough to achieve the desired refraction.

The study's importance stems from the large sample size, the large number of measurement series, and the consistent recording of data from the analyzed participants. However, it's conceivable to find fault with the fact that axis changes in cylinder power weren't accounted for. A study of vector components is required for this purpose. We did not recalculate for this study since astigmatism vector data is more difficult to read than cylinder magnitude and axis. It's important to remember that the type of IOL used in the procedure can have an effect on the recovery time and post-op astigmatism in addition to the incision size and placement. In order for the findings to be applicable, both the surgical method and the kind of IOL used must be the same, which was the case here. In addition, The degree to which best-corrected visual acuity VCC stabilises after cataract surgery is not evident from this data. There is no correlation between visual acuity and the refraction itself if the refraction is determined objectively. On the other hand, others may contend that refraction can only be quantified reliably by means of an a priori subjective approach. However, the accuracy of contemporary autorefractors is at least as good as or better than that of a subjective refraction measurement, therefore this claim can be challenged.

Conclusions

While other measures of post-operative stability, such as central corneal thickness, effective lens position, and visual acuity, can take up to four weeks to stabilise, these results suggest that in the majority of patients, refractive error can be measured and corrected as early as one week after surgery. For this reason, it may be prudent to wait 4 weeks after a simple phacoemulsification cataract surgery before undergoing refractive correction. Eyes with an emmetropic prescription recover from cataract surgery with less time spent in the glasses or contacts' phase. Based on these findings, it appears that the earliest point at which reading glasses should be prescribed to this population of patients is three weeks after surgery. This study confirms the findings of other authors that significant clinical precision can be achieved in determining the refraction of a pseudophakia eye as early as one to three weeks following an uncomplicated cataract operation. As a result, the time it takes to prescribe glasses for presbyopia or other residual refractive problems decreases, and the number of follow-up appointments required to check a stable refraction decreases as well.

REFERENCE

1. Mrugacz, M.; Olszewski, M.; Pony-Uram, M.; Brymerski, J.; Bryl, A. Assessment of the Refractive Error and Stabilisation of Refraction after Cataract Surgery in Relation to the Length of the Eyeball. J. Clin. Med. 2022, 11, 5447. https://doi.org/ 10.3390/jcm11185447

2. McNamara, P.; Hutchinson, I.; Thornell, E.; Batterham, M.; Iloski, V.; Agarwal, S. Refractive stability following uncomplicated cataract surgery. Clin. Exp. Optom. 2019, 102, 154–159.

3. Charlesworth, E.; Alderson, A.J.; de Juan, V.; Elliott, D.B. When is refraction stable following routine cataract surgery? A systematic review and meta-analysis. Ophthalmic Physiol. Opt. 2020, 40, 531–539

4. Ostri, C.; Holfort, S.K.; Fich, M.S.; Riise, P. Automated refraction is stable 1 week after uncomplicated cataract surgery. Acta Ophthalmol. 2018, 96, 149–153.

5. Berk, T.A.; Schlenker, M.B.; Campos-Moller, X.; Pereira, A.M.; Ahmed, I.I.K. Visual and Refractive Outcomes in Manual versus Femtosecond Laser-Assisted Cataract Surgery: A Single-Center Retrospective Cohort Analysis of 1838 Eys. Ophthalmology 2018, 125, 1172–1180.

6. Lundström, M.; Barry, P.; Henry, Y.; Rosen, P.; Stenevi, U. Evidence-based guidelines for cataract surgery: Guidelines based on data in the European Registry of Quality Outcomes for Cataract and Refractive Surgery database. J. Cataract. Refract. Surg. 2012, 38, 1086–1093.

7. Liu, B.; Xu, L.; Wang, Y.X.; Jonas, J.B. Prevalence of cataract surgery and postoperative visual outcome in greater Beijing: The Beijing Eye Study. Ophthalmology 2009, 116, 1322–1331

8. De Juan, V.; Herreras, J.M.; Pérez, I.; Morejon, A. Refractive stabilization and corneal swelling after cataract surgery. Optom. Vis. Sci. 2013, 90, 31–36.

9. Aristodemou, P.; Knox Cartwright, N.E.; Sparrow, J.M.; Johnston, R.L. Formula choice: Hoffer Q, Holladay 1, or SRK/T and refractive outcomes in 8108 eyes after cataract surgery with biometry by partial coherence interferometry. J. Cataract. Refract. Surg. 2011, 37, 63–71.

10. Lee, A.C.; Quazi, M.A.; Pepose, J.S. Biometry and intraocular lens power calculation. Curr. Opin. Ophthalmol. 2008, 19, 13–17.

11. Ghanem, A.A.; El-Sayed, H.M. Accuracy of intraocular lens power calculation in high myopia. Oman J. Ophthalmol. 2010, 3, 126–130.

12. Wang, X.G.; Dong, J.; Pu, Y.L.; Liu, H.J.; Wu, Q. Comparison axia lenghth measurements from three biometric instruments in high myopia. Int. J. Ophthalmol. 2016, 9, 876–880.

13. Rajan, M.S.; Keilhorn, I.; Bell, J.A. Partial coherence laser interferometry vs. conventional ultrasound biometry in intraocular lens power calculations. Eye 2002, 16, 552–556.

14. Atwa, F.A.; Kamel, H.S.; Kamel, R.M.; Abd El Fatah, A.A. Refractive Outcomes after Phacoemulsification Using Optical Biometry versus Immersion Ultrasound Biometry. Egypt J. Hosp. Med. 2019, 75, 2806–2812.

15. Khan, A., Waldner, D.M., Luong, M. *et al.* Stabilization of refractive error and associated factors following small incision phacoemulsification cataract surgery. *BMC Ophthalmol* **22**, 13 (2022). https://doi.org/10.1186/s12886-021-02221-w