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The Accuracy of Biometrics on Patients After Cataract Surgery in The Ophtalmic Ward of Waled Regional Public Hospital in Year 2022

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KEYWORDS

Biometric accuracy; cataract surgery; IOL Lens

ABSTRACT

Cataracts are the leading cause of preventable blindness in the world, and Cataract surgery is the second most frequently performed surgical procedure in the world. Before surgery, a measurement procedure is performed to determine the accuracy of the IOL, the biometric measurement procedure is very important to determine the size of the IOL to be implanted to replace the natural lens in patients suffering from cataracts because if there is an error during the calculation procedure, it can cause postoperative refractive abnormalities. Determine the accuracy of biometric calculations in patients after cataract surgery at Waled Regional General Hospital, Cirebon in 2022. This study uses an observational design, retrospective descriptive. The research was carried out through observation of secondary data from the medical records of post-cataract patients at Waled Hospital, Cirebon in 2022 using total sampling and analyzed using univariate analysis. The accuracy of biometric calculation in patients undergoing cataract surgery, after obtaining glasses correction then spherical equivalent calculations were carried, in the accurate category (-1.99 – 1.99) there were 365 eyes (92.2%), while in the inaccurate category (> ±2), 31 eyes (7.8%). Therefore, the results of this study show that the calculation of biometric lenses is quite accurate with the most numbers in the good category, with a percentage of 92.2%. The accuracy of biometric calculations amounted to 365 (92.2%), out of a total of 396 eyes in 220 patients and it is said to be accurate in Waled Public Hospital.

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INTRODUCTION

Several studies have examined biometric accuracy in post-cataract surgery patients at various healthcare facilities. A study conducted by Natan PC, Triharpini NN, and Sucicahyati D (2023) at the Eye Clinic of Mangusada Badung Regional Hospital on 41 patients showed an average post-operative spherical equivalent of -0.49 ± 1.08 D with a range of -2.87 to 1.75 D. Another study by Tang et al., (2020) on 909 patients at a Teaching Hospital obtained an average IOL power of 20.6 D in both eyes, and found that the third formula used for preoperative IOL calculations did not show a significant difference with an average calculation error of only 0.38

D. Meanwhile, research by Andalia dan Kamal (2020) at Cipto Mangunkusumo General Hospital on 506 patients found a biometric value of 82% with a range of <0.25 D (Melisa Sihite, 2019; Ilyas & Yulianti, 2015). Research by Khoramnia R, Auffarth G, Labuz G, et al. (2022) Identifying factors that influence the final refractive outcome after cataract surgery, which are divided into pre-operative factors (axial length, corneal power, anterior chamber depth) and intra-operative factors (surgical technique, incision size) (Astari, 2018). However, these studies were generally conducted in type A or B hospitals with varying patient characteristics, while research at Waled Regional Hospital, Cirebon Regency, which is a type C hospital with a wide service area has never been conducted before. Furthermore, most previous studies focused more on comparing IOL formulas or factors that influence accuracy, without providing a descriptive overview of biometric accuracy based on spherical equivalent calculations in the accurate (-1.99D to 1.99D) and inaccurate (> ±2D) categories in the post-cataract surgery patient population.

Cataracts are a state of cloudiness in the lens that can occur due to hydration or addition of lens fluid, lens protein denaturation, or both, this usually causes the patient to feel like his vision is covered by a waterfall (Mustafa et al., 2019; Lender et al., 2022; Sánchez-Liñan et al., 2023). Cloudiness usually occurs in both eyes of the patient, is progressive, or does not undergo changes over a long period of time (Kumari et al., 2019).

Cataracts are the leading cause of preventable blindness in the world. The World Health Organization (WHO, 2014) estimates that of all blindness events globally, cataracts were responsible for 51% of these events, or about 20 million people in 2014 (Motley & Asbury, 2018). Based on the Rapid Assessment of Avoidable Blindness (RAAB), which is a collection of valid fundamental data for blindness evaluation, conducted in Indonesia between 2014 and 2016, the findings of a survey from 14 provinces, cataracts were cited as the main cause of vision disorders and blindness in Indonesia, where the prevalence of blindness was 3%.

The prevalence of blindness on all islands in Indonesia, West Java occupies the second place after East Java with an incidence of 180,666. Of the entire island, cataracts were the most frequent cause (71.7%-95.5%) (Rif'Ati et al., 2021).

Cataract surgery is the second most frequently performed surgical procedure in the world. The method that is often done is to preserve the posterior part of the lens capsule, known as the extracapsular cataract extraction method, the phacoemulsification technique is a form of extracapsular cataract extraction that is often used in developing countries (Buratto et al., 2024; Chen et al., 2021; Lapp et al., 2023). This surgery is carried out by replacing natural lenses with artificial lenses with the goal of achieving near-normal visual acuity without the need to use glasses, the lens used in this cataract surgery is an intraocular lens.

Before surgery, axial length, anterior chamber depth, and lens thickness are measured for cataract assessment, therefore the cooperation of the patient, technician or doctor who performs this examination is needed to be able to obtain the most accurate measurements, if there is an error it can cause postoperative refractive disorders.

To achieve the closest accuracy, it is necessary to have good surgical procedures, surgical techniques, and accurate biometric measurements including formulation accuracy to determine the Intraocular Lens Power.

As time goes by, patients have greater expectations for post-cataract surgery results to get good vision or visual skills without wearing glasses.

In a study at Mangusada Regional Hospital conducted in 2023 with the aim of determining the accuracy of IOL calculations undergoing phacoemulsified cataract surgery and SICS, it was found that the accuracy of ultrasound biometrics is quite good, but biometric operators need to get thorough investigation to improve the accuracy of postoperative cataract surgery results, because biometric machines are known to require routine calibration.

Meanwhile, based on a study conducted at Cipto Mangunkusumo Hospital by Andalia D, and Kamal YE, with the aim of comparing IOL accuracy calculations in patients undergoing phacoemulsified cataract surgery with immersion biometry implantation. In this study, from 506 patients examined, biometric accuracy was obtained with a percentage of 82% with a range of <0.25 D. The results of this refractive estimate had a positive correlation with the postoperative spherical equivalent.

The tools used to calculate the strength of the IOL have a high risk of use, and this affects the safety of the patient, so errors in the calculation of the IOL can also cause postoperative refractive errors that cannot be anticipated (Tjokrovonco et al., 2021; Dewi, 2023; Astari, 2018). Therefore, this study aims to be a consideration in calculating the exact power of IOL, and with more satisfactory results for patients who will undergo cataract surgery.

This study offers several novelties that distinguish it from previous studies. First, substantively, this study specifically describes the accuracy of biometric calculations in post-cataract surgery patients at Waled Regional Hospital, Cirebon Regency, in 2022, a previously unstudied study. Second, this study uses secondary data from medical records with a total sampling of 396 eyes from 220 patients, thus providing a comprehensive and representative picture of biometric accuracy in a type C hospital with a wide service area. Third, this study categorizes accuracy based on spherical equivalent calculations with a clear range: accurate (-1.99D to 1.99D) and inaccurate (SE values outside this range), in contrast to previous studies that generally used narrower ranges (<0.25D or ±0.5D). Fourth, this study presents complete data on the average power of the implanted IOL (20.6 D with a range of -2.00 to 29.5 D) and the average postoperative spherical equivalent (-1.03 D with a range of -2.50 to 0.00 D) which can be the basis for evaluating and improving the quality of cataract surgery services at Waled Regional Hospital. Thus, this study not only provides theoretical contributions to the development of ophthalmology, but also provides important basic data for improving the quality of cataract surgery services in type C hospitals in particular and in Indonesia in general.

This study was conducted with the general objective of determining the accuracy of biometric calculations in post-cataract surgery patients at the Eye Department of Waled Hospital, Cirebon Regency in 2022. This research is expected to provide theoretical benefits for the development of ophthalmology, particularly in enriching the understanding of the accuracy of biometry calculations in post-cataract surgery patients in type C hospitals. Practically, the results of this study can be used as evaluation material for ophthalmologists in improving the accuracy of pre-operative biometry calculations and as input for hospital management to improve the medical data documentation system. For future researchers, this study can be used as a basic reference to further examine the factors that influence biometry accuracy and IOL formula comparison.

This study has theoretical implications for the development of ophthalmology, particularly in strengthening the understanding that the accuracy of biometric calculations in post-cataract surgery patients can reach a good category (92.2%) in a type C hospital, indicating that the quality of cataract surgery services in regional hospitals is not inferior to type A or B hospitals. This finding also emphasizes the importance of spherical equivalent calculations as an indicator of post-operative biometric accuracy. Practically, this study has implications for the need to improve the documentation and storage system of medical data at Waled Regional Hospital, considering that a large amount of IOL calculation data is lost or removed from medical records and therefore cannot be analyzed. Digitizing medical records is an urgent need to facilitate data tracking and future service evaluation. For healthcare professionals, this study has implications for the need for routine calibration of biometric devices and improvement of operator competence in performing measurements, considering that measurement accuracy is strongly influenced by pre-operative factors such as axial length and corneal strength. For patients, the impression from this study further increases confidence that cataract surgery at Waled Regional Hospital has a good level of accuracy, so it is hoped that it will increase the coverage of cataract surgery services in Cirebon and the surrounding area. This study also implies the need for further research with an analytical design to examine the relationship between various factors (age, gender, surgical technique, IOL formula) with the accuracy of post-cataract surgery refraction results.

METHOD

This study uses an observational design, namely retrospective descriptive. The research was carried out through observation of data taken in the form of secondary data from the medical records of post-cataract surgery patients at Waled Hospital, Cirebon in 2022 which had gone through the licensing process.

Study design/ Research procedures

Sampling was carried out using the total sampling technique, whose sample size is the same as the target population and meets the inclusion and exclusion criteria, in this study, the total number of patients who met the inclusion criteria was 574 patients, and 354 patients met the exclusion criteria, because medical record data in the form of incomplete or missing data of the IOL power calculations, as well as patients who were not controlled after the cataract surgery. The total sample in this study after adjusting for inclusion and exclusion criteria was 396 eyes from 220 patients.

Measurements

A single variable in a study is defined as an image used as a characteristic, attitude, and measure possessed in the research regarding the concept of a particular research. In this study, the single variable is biometric accuracy in post-cataract surgery patients at the Waled public hospital, particularly in the eye department. The data obtained at the research site was in the form of medical records, the researcher analyzed the medical records of each patient who

underwent cataract surgery in 2022 with a total sample of 396 cases according to the inclusion criteria.

Statistical techniques

This study uses univariate analysis with the results provided in textual table.

Ethical Clearance

The results of this research are with the permission of the Health Research Ethics Committee of Waled Regional Hospital No. 000.9.2/025/KEPK/V/2024 and through a Research Certificate by the Agency for National Unity and Politics (KESBANGPOL) of Cirebon No. 000.9.2/942/Wadnas and PK. Then contacted the Education and Training division of Waled Hospital to obtain a license from the director of the Hospital with the official letter in No. 800.2.2.1/1183.b-DIKLIT/2024

RESULT AND DISCUSSION

The mean calculation of power IOL lenses that are planted on the patients.

Table 1. Mean calculation of IOL power

	Power IOL (D)
Mean	20.6
Minimum	-2.00
Maximum	29.5

Source: Primary research data (2024).

Based on the data obtained in table, the average or mean calculation of IOL power of 396 eyes on 220 data of patients who have been recapitulated is 20.6 D, with a range of -2.00 - 29.5 D.

The results of this study are in line with the results of a study conducted by Tang et al., (2020) on 909 patients who underwent cataract surgery at the Teaching Hospital in 2020. This study obtained an average result of IOL strength of 20.6 D in both eyes.

In the study, it was also said that there is a possibility that the influence of the formula or formula used with the final result of the IOL calculation measured, is also influenced by the axial length of each eye of the patient. However, in the final results of the study, it was said that the three formulas used for the calculation of IOL before surgery, no significant results were found. All formulas used resulted in only 0.38 D and the mean calculation error ±0.25 D (42.7%) and ±0.5 D (75.5%) from the initial prediction.

The Accuracy of Biometrics Within a Calculation on Spherical Equivalent (SE) on Patients After Cataract Surgery

Mean accuracy of biometrics with spherical equivalent calculation.

Table 2. SE results on patients after cataract surgery.

	SE results (D)
Mean	-1.03
Minimum	-2.50
Maximum	0.00

Source: Primary research data (2024).

Based on the data in the table that the researcher has obtained and then passed the calculation, the average postoperative spherical equivalent (SE) is -1.03 D with a range between -2.50 – 0.00 D.

The results of this study are in line with research conducted by Natan PC, Triharpini NN, and Sucicahyati D, who conducted a study on 41 patients at the eye polyclinic of Mangusada Badung Hospital in 2022 with an average result of -0.49 ± 1.08 D, while the range of spherical equivalent results in postoperative was -2.87 – 1.75 D.

Table 3. The percentage of frequency on biometric accuracy results

Biometric accuracy based on spherical equivalent calculations	Frequency (n)	Percentage (%)
Accurate (-1,99D to 1,99D)	365	92,2%
Not accurate (The value of the SE calculation results other than the accurate category)	31	7,8%
Total	396	**100%**

Source: Primary research data (2024).

Based on the data, the accuracy of the biometric calculation obtained in patients undergoing cataract surgery and after obtaining glasses correction then a spherical equivalent calculation was carried out, in the accurate category (-1.99 to 1.99 D) there were 365 eyes (92.2%), while the category was inaccurate (The value of the SE calculation results other than the accurate category), obtained 31 points (7.8%). Therefore, the results of this study show that the calculation of biometric lenses is quite accurate with the most numbers in the good category, with a percentage of 92.2%.

The factors that can affect the final result in the calculation of spherical equivalent (SE) compared to the strength of the IOL after surgery in the same study are the age of the patient, visual demands, and also ocular characteristics.

In a study conducted by Khoramnia R, Auffarth G, Labuz G, et al, in 2022, it was known that there are several factors that affect the final outcome of refraction after cataract surgery, some of these factors are divided into pre-operative, intra-operative factors.

a. Pre-operative factors

The pre-operative factor includes the measurement of axial length which is very important to obtain accuracy, because according to the research conducted, it is known that errors in the measurement of axial length can cause errors in the refraction results as much as ~0.27 D. Another pre-operative factor is the measurement of corneal strength which can cause an error of 0.5 D if there is a measurement or keratometry error. Several pre-operative factors were also mentioned such as the calculation of the strength of the IOL, the depth of the anterior occupancy camera, and the astigmatism that had been suffered before cataract surgery.

b. Intra-operative factors

The main intra-operative factor is the surgical technique, which can affect the final outcome of cataract surgery refraction. Optimal refractive results can be produced with good surgical techniques, aiming to minimize the possibility of posterior capsular rupture, and having a capsulorhexis size smaller than the optical diameter, with this, it can achieve a stable position and produce good predictability. In addition, eyes with larger enlarged incisions tend to cause SIA or surgically induced astigmatism, which is astigmatism that occurs at the time of surgery.

CONCLUSION

The accuracy of biometric calculations based on spherical equivalents < -1.99 to 1.99 D amounted to 365 (92.2%), out of a total of 396 eyes in 220 patients at Waled hospital so it is said to be accurate. Therefore, this research has been completed, but when the data collection process at the research site took place, the researcher faced limitations, namely that the data storage system at Waled Hospital was not yet digital, so the search for documents for this study was quite time-consuming. The results of biometric calculations are generally in the form of attached paper and stickers, and in the majority of recapitulation documents, it is found that the attachments are independent of the medical record and are missing, so that many samples in this study are included in the exclusion criteria. Further research is expected to be helped by the reference of basic information in this study regarding the accuracy of biometric calculations before cataract surgery, and can develop the results of this study so that the results of future research are better.

REFERENCES

Andalia, D., & Kamal, Y. E. (2020). Accuracy of immersion biometry for cataract surgery in refraction division Cipto Mangunkusumo Hospital 2013–2014. Ophthalmologica Indonesiana, 46(2), 162. https://ophthalmologica.perdami.or.id/index.php/journal/article/view/100094

Astari, P. (2018). Katarak: Klasifikasi, tatalaksana, dan komplikasi operasi. CDK, 45(10), 748–753.

Buratto, L., Brint, S., & Sacchi, L. (2024). *Cataract surgery: introduction and preparation*. CRC Press.

Chen, X., Xu, J., Chen, X., & Yao, K. (2021). Cataract: advances in surgery and whether surgery remains the only treatment in future. *Advances in Ophthalmology Practice and Research*, *1*(1), 100008.

Dewi, A. U. (2023). Effect of hydrophobic intraocular lens optical design model on posterior capsule opacification (PCO) postoperative cataract. Farmaka, 21(1). https://doi.org/ (jika tersedia)

Health Research and Development Agency of the Ministry of Health of the Republic of Indonesia. (2024). Results of the 2014–2016 rapid assessment of avoidable blindness survey in Indonesia. Ministry of Health of the Republic of Indonesia.

Ilyas, S., & Yulianti, S. R. (2015). Ilmu penyakit mata (5th ed.). Badan Penerbit FKUI.

Khoramnia, R., Auffarth, G., Łabuz, G., Pettit, G., & Suryakumar, R. (2022). Refractive outcomes after cataract surgery. Diagnostics, 12(2), 243. https://doi.org/10.3390/diagnostics12020243

Kumari, R., Srivastava, M. R., Garg, P., & Janardhanan, R. (2019). Intraocular lens technology: A review of journey from its inception. Ophthalmology Research: An International Journal, 11(3), 1–9.

Lapp, T., Wacker, K., Heinz, C., Maier, P., Eberwein, P., & Reinhard, T. (2023). Cataract surgery—indications, techniques, and intraocular lens selection. *Deutsches Ärzteblatt International*, *120*(21–22), 377.

Lender, R., Mirsky, D., Greenberger, R., et al. (2022). Evaluation of three biometric devices: Ocular parameters and calculated intraocular lens power. Scientific Reports, 12, 19478. https://doi.org/10.1038/s41598-022-24017-8

Melisa Sihite, P. (2019). Pemeriksaan diagnostik preoperasi dalam operasi katarak. Fakultas Kedokteran Universitas Padjadjaran.

Motley, W. W., & Asbury, T. (2018). Vaughan & Asbury's general ophthalmology (19th ed.). McGraw-Hill Education.

Mustafa, M. Z., Khan, A. A., Bennett, H., Tatham, A. J., & Wright, M. (2019). Accuracy of biometric formulae in hypermetropic patients undergoing cataract surgery. European Journal of Ophthalmology, 29(5), 510–515. https://doi.org/10.1177/1120672118803509

Natan, P. C., Triharpini, N. N., & Sucicahyati, D. (2023). Immersion biometric accuracy in cataract surgery at the eye polyclinic of Mangusada Badung Hospital in 2022. Udayana Medical Journal, 12. https://doi.org/ (jika tersedia)

Rif'Ati, L., Halim, A., Lestari, Moeloek, N., & Limburg, H. (2021). Blindness and visual impairment situation in Indonesia based on rapid assessment of avoidable blindness surveys in 15 provinces. Ophthalmic Epidemiology, 28(5), 408–419. https://doi.org/10.1080/09286586.2020.1853178

Sánchez-Liñan, N., Pérez-Rueda, A., Parrón-Carreño, T., et al. (2023). Evaluation of biometric formulas in the calculation of intraocular lens according to axial length and type of the lens. Scientific Reports, 13, 4678. https://doi.org/10.1038/s41598-023-31970-5

Tang, K. S., Tran, E. M., Chen, A. J., Rivera, D. R., Rivera, J. J., & Greenberg, P. B. (2020). Accuracy of biometric formulae for intraocular lens power calculation in a teaching hospital. International Journal of Ophthalmology, 13(1), 61–65. https://doi.org/10.18240/ijo.2020.01.09

Tjokrovonco, L., Knoch, A., Budiman, & Sugiarti, E. (2021). Lensa intraokular piggyback sekunder sebagai tatalaksana refractive surprise. Ophthalmologica Indonesiana, 47(1), 14–19. https://ophthalmologica.perdami.or.id/index.php/journal/article/view/100144