Comparison of Anterior Chamber Depth Before and After Cataract Surgery by Phacoemulsification with IOL Implantation

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ABSTRACT

Purpose: The study aimed to compare the changes in anterior chamber depth (ACD) before and after cataract surgery by phacoemulsification with implantation of intraocular lens in posterior chamber.

Methodology: This was comparative pre and post-operative observational study in which 75 patients were included who underwent cataract removal surgery via phacoemulsification with implantation of posterior chamber IOL. ACD WAs measured on A-scan before surgery and after surgery at 1 week and 1 month. Paired sample T test was applied to check for statistical significance. P value less than 0.05 was considered significant.

Results: Out of 75 patients who participated in this study, there were 31 (41.3%) males and 44 (58.7%) females. The mean anterior chamber depth elevated from 2.9548 ± 0.41785 mm to 3.1928 ± 0.31698 mm with a mean increase of -0.23800 ± 0.44520 mm. A statistically significant (P=0.000) variation was seen in the mean change in the anterior chamber depth.

Conclusion: The anterior chamber was deepened by phacoemulsification and IOL implantation.

Key Words: Cataract, Anterior chamber depth, Phacoemulsification.

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INTRODUCTION

Senile cataract, often known as "age-related cataract," is the most prevalent type of cataract, which affecting people of all genders equally and typically developing after the age of 40. Over 90% of people develop acquired cataracts by the age of 70.[1,2] The only appropriate treatment for cataracts is surgery. Cataracts can be removed when a patient is under general or local anaesthesia.[1] The most widely used technique for extracapsular cataract extraction at the moment is phacoemulsification.[3]

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Phacoemulsification is a surgical technique for cataract removal with implantation of intraocular lens. It is the most widely used technique in the world and, in certain highly developed nations, has essentially replaced all others. With this method, ultrasonic vibrations are used to break down the cataractous lens.[1,3,4]

Today, it is widely accepted that, moreover to the removal of damaged tissue, cataract surgery also incorporates components of refractive and presbyopic surgery. During cataract surgery, implantion of an intraocular lens (IOL) with the proper calculation of power improves patient satisfaction and results in a successful procedure. According to Norrby et al., the majority of IOL power prediction errors were attributable to preoperative predictions of anterior chamber depth [ACD] or postoperative location of IOL after surgery.[5]

The authors also stated that a refractive error of 1.44 Diopter for an eye with average dimensions is represented by an approximate 1 mm error in the ACD following surgery; this finding was confirmed using ray tracing methods. Therefore, lowering postoperative refractive error requires enhancing the IOL position's prediction accuracy. The postoperative ACD that is considered in popular third-generation IOL power measurement formulas (SRK/T, Holladay, and Hofer) is computed using thin lens formulas, which does not adequately represent the postoperative ACD in the anatomical sense. As a result, it differs from the real lens position. The postoperative ACD is calculated using equations based on data of mean (K-readings) Keratometry and axial length (AL).[5]

The anterior chamber depth (ACD) must be precisely measured in order to protect patients undergoing refractive implantation of intraocular lens (IOL) surgery. ACD is one of the most frequently measured critical factors in the assessment of accommodative potential due to the increasing interest in treatment of presbyopia and the introduction of potentially accommodating IOLs. The more recent generation of IOL power calculation formulas, which provide precise ACD measurements crucial for modern refractive lens surgery, also incorporates the 3-5 ACD.[5,6]

Anterior chamber depth is a postoperative indicator of the axial position of the IOL (also known as the ELP). According to ELP, forward IOL deviation causes myopia whereas hyperopia results from the opposite. Olsen discovered that inaccurate estimation of the postoperative ACD was responsible for 42% of IOL power prediction errors, which indicates that using the postoperative ACD in the computation of the IOL power is probably an effective way to lower postoperative error. The importance of ACD in addressing postoperative RE deserves additional research.[8] The effective distance between the anterior surface of the cornea and the IOL plane is known as the effective lens position, or ELP.[9,10,11]Approximately 42% of the entire inaccuracy in the refractive forecast comes from the ELP prediction.[10]

ACD is impacted by phacoemulsification due to mechanical and patient variables. Examples of mechanical considerations include IOL design, IOL thickness, and phacoemulsification machine settings. Patient considerations include the degree of the cataract, the effectiveness of the wound closure, the strength of the zonules, anxiety, eye movements, etc. ACD is one of the important factors that is most usually used when evaluating the likelihood of an accommodating IOL.[12] The most common tool used to measure ocular biometric components is ultrasound A-scan biometry.[6]

This study aimed to compare the anterior chamber depth changes following before and after the posterior chamber intraocular lens implantation and cataract surgery using phacoemulsification.

METHODOLOGY

This study employed pre and post-operative observational comparative design and was conducted on patients who were advised to undergo surgery for senile cataract by means of phacoemulsification at Department of

Ophthalmology, FMH. Seventy five patients with the age range of 40 to 85 years were sampled using a non-probability consecutive sampling technique over a six-month period from August 2022 to January 2023. The exclusion criteria mentioned here were applied; history of ocular trauma, history of intraocular surgery (apart from lens removal cataract surgery), history of corneal disease or infection, history of ocular diseases (such as uveitis, pterygium, glaucoma, or ocular tumor), and records of surgical complications.

Detailed history and examination including (BCVA) best corrected visual acuity, dilated fundus examination, keratometry and anterior chamber depth (ACD) were carried out before surgery. The postoperative examination included slit-lamp examination of the anterior segment, visual acuity and ACD. The follow-up was conducted at 1 week and after the 1 month to measure anterior chamber depth (ACD) by A-scan ultrasound after instillation of local anaesthesia proparacaine hydrochloride 0.5% drops. Patients with senile cataract who underwent for phacoemulsification cataract surgery were included. Phacoemulsification was carried out, utilizing horizontal chopping procedure and posterior chamber intraocular lens (foldable hydrophobic lens) was implanted under anaesthesia by ophthalmologist. Self-designed Performa and Sonomed Ultrasound A-Scan 100A+ were used to collect the data. Data was entered and analysed using IBM SPSS V-26. Qualitative data was represented by frequencies, percentages, bar charts and graphs whereas quantitative data was represented by minimum value, maximum value, mean and standard deviation. The paired/dependent sample t-test was employed to compare pre and post values. A p value ≤ 0.05 was regarded statistically significant. No subject was put on experiment. As it is observational study so there was no ethical issue or any religious barrier in this study.

RESULTS

For the 75 cataract patients includes whose data were complete at 1 week and one month postoperative, 75 patients were studied overall, and 31 (41.3%) were males and 44 (58.7%) female patients. The age of the patients ranged from 40 years to 83 years with a mean of 57.96 years. The male and female were found in frequency and percentages presented in Table 1 and Figure 1 using the results of SPSS.For the 75 cataract patients includes whose data were complete at 1 week and one month postoperative, 75 patients were studied overall, and 31 (41.3%) were males and 44 (58.7%) female patients. The age of the patients ranged from 40 years to 83 years with a mean of 57.96 years. The male and female were found in frequency and percentages presented in Table 1 and Figure 1 using the results of SPSS.(14%) were of the age group 70 and above years. Mean age was found to be 55.86 ± 12.226. Out of total 50 (100%) participants 21 (42%) were male while 29 (58%) were female. Among total of 50 (100%) participants, 6 (12%) had myopic refractive error, 14 (28%) had hyperopic refractive error while 30 (60%) had astigmatism. Among the total participants 50 (100%), the age group of 40 – 55 years 4 (8%) were myopes, 8 (16%) were hyperopes while 9 (18%) had astigmatism. Among the age group of 55 – 70 years 1 (2%) had myopia, 4(8%) were hyperope while 9 (18%) were astigmatism. Among those who were age 70 and above years 5 (10%) had myopia, 14 (28%) had hyperopia and 36 (72%) had astigmatism. Among total of 50 (100%) participants of our study the male participants, 3 (6%) were myopes, 4 (8%) were hyperope while 16 (32%) had astigmatism. Among the female participants 3 (6%) were myopes, 10 (20%) were hyperope while 16 (32%) had astigmatism.

Table -1: Frequency Distribution of Gender

	Frequency	Percent
Male	31	41.3
Female	44	57.7
Total	75	100

Table 2 and Figure 2 presented the 23 (69.3%) patients had previous surgery and 23 (30.7%) had no previous surgery.

Figure -1: Frequency Distribution of Gender

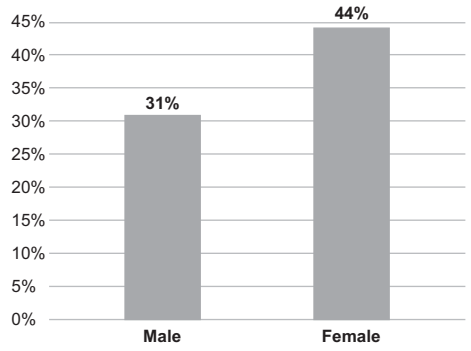


Table - 2: Frequency Distribution of Patients by Previous Surgery

	Frequency	Percent
No	52	69.3
Yes	23	30.7
Total	75	100

Figure -2: Frequency Distribution of Previous Surgery

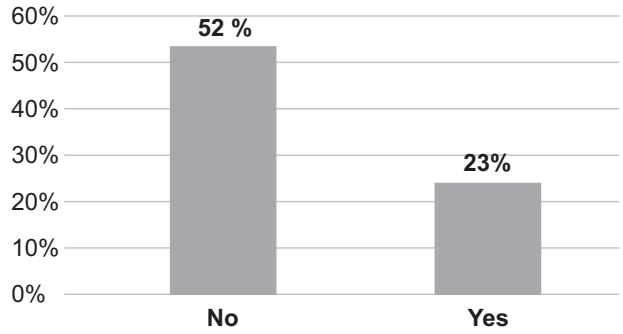
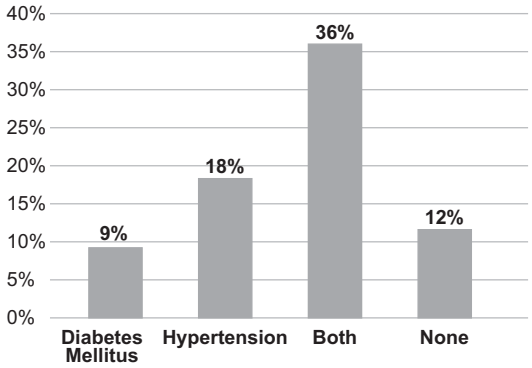


Table 3 and Figure 3 shown that there were 63 (84%) patients who had medical history of systemic disease and 12 (16.0%) patients had no medical history. The most common systemic disease was combination of diabetes mellitus and hypertension (both) in 36 (48.0%), followed by hypertension in 18 (24.0%), diabetes mellitus type in 9 (12.0%).

Table -3: Frequency Distribution of Medical History

	Frequency	Percent
Diabetes Mellitus	9	12.0
Hypertension	18	24.04
Both	36	8.01
None	12	6.0
Total	75	100.0

Figure 4.3: Frequency Distribution of Medical History

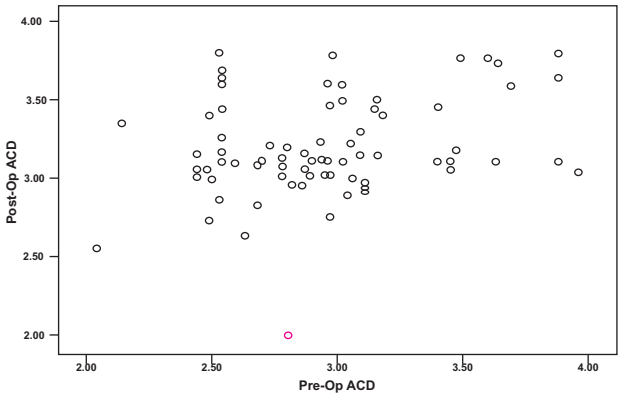


The mean anterior chamber depth elevated from 2.9548 ± 0.41785 mm to 3.1928 ± 0.31698 mm with a mean increase of -0.23800 ± 0.44520 mm. The mean change in anterior chamber depth showed a statistically significant difference.

Table -4: Mean preoperative and postoperative anterior chamber depth

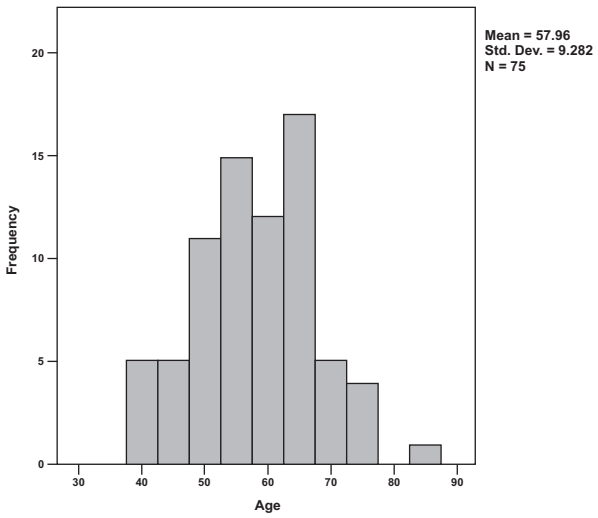
	Mean	N	P-value
Pre-Op ACD	2.9548±0.41785	75	0.000
Post-Op ACD	3.1928±0.31698	75	

Figure -4: Anterior chamber depth (ACD): correlation between preoperative and postoperative values



For the descriptive of quantitative variables, the mean age of the participants was 57.96 with a wide spread of 9.282. The minimum age recorded was 40 and maximum value being 83.

Figure -5: Mean age of respondents



DISCUSSION

A key component of the eye's refractive system is the crystalline lens. By replacing a damaged inelastic lens with an intraocular lens, the phacoemulsification technique used in modern cataract surgery helps to improve eyesight. Anterior chamber depth and anterior chamber angle have a strong correlation. Deep anterior segment morphological changes may result with phacoemulsification surgery, particularly in eyes where anterior chambers (AC) are shallow and anterior chamber angles (ACA) are narrow.[13,14] The depth of the anterior chamber (ACD), which measures roughly 3 mm, is the area that separates the back of cornea and the crystalline lens's anterior surface. The ACD has been shown to be impacted by age, gender, refractive error, and cataract development.[15,16]

Analyses of the anterior chamber characteristics are a crucial component of the evaluation of the eyes. There are various ways to measure anterior segment characteristics. A number of authors used a variety of approaches to examine changes in certain anterior chamber characteristics following routine phacoemulsification. Clinical research showed that irido-corneal angle widening, lower intraocular pressure (IOP), and higher ACD result from cataract extraction.[17,18]

Due to the fact that practically all IOL calculations require AL as a variable, accurate measurement of AL has long been seen as being crucial. Even in eyes with the same K and AL, different formulas' accuracy may vary according on ACD. In their examination of 91 eyes, Jeong et al. investigated the connection between the expectations discrepancies in the formulas and the preoperative biometric characteristics. They deduced that the primary reason behind the variation between Haigis formula and the formulation from third-generation was preoperative ACD. In eyes with short AL and shallow ACD, ACD-based predicted refractions were more accurate than those made without taking ACD into account.[19,20]

Anterior chamber depth increased from 2.76±0.08mm preoperatively to 3.95±0.05 mm postoperatively, according to a previous study, with a mean change of 1.20±0.06mm occurring six months later. In eyes with glaucoma, a different study revealed that the anterior chamber depth increased after cataract surgery.[13]

In current study, the mean age of the patients was 57.96 years. The mean ACD depth of anterior chamber elevated from 2.9548 ± 0.41785 mm to 3.1928 ± 0.31698 mm with a mean rise of -0.23800 ± 0.44520 mm. A statistically significant results are obtained ($p<0.05$).

Following phacoemulsification, Morocco observed similar reductions in mean intraocular pressure (2.25 mmHg), from 14.18±3.4 to 12.07±2.6 mmHg in healthy subjects. The average anterior chamber depth increased similarly, 1.13 mm, from 2.96 mm to 4.09 mm, according to their findings. Following phacoemulsification in healthy patients, Liu et al. showed a comparable drop raise in mean anterior chamber depth (2.38±0.32 mm to 3.04±0.39 mm) and mean IOP (14.86±3.79 mmHg to 12.17±4.22 mmHg). Qu et al. reported a corresponding drop in mean IOP (14.3±3.1 mmHg to 12.7±3.3 mmHg) and an equivalent rise in mean ACD (2.54±0.41 mm to 3.99±0.33 mm).[13]

The present study's findings are consistent with previously published studies that address the topic and show that phacoemulsification and implantation of IOL can help glaucoma patients by deepening the anterior chamber and lowering

intraocular pressure in addition to improving visual clarity by eliminating the cataract.

CONCLUSION

The anterior chamber was deepened by phacoemulsification and IOL implantation, which is sustained throughout a month, regardless of gender or the age of the cataract, may be helpful for glaucoma patients.

Conflict of Interest: None to declare

Ethical Approval: The study was approved by the Institutional Review Board / Ethical Review Board Vide No.FMH/12/08/2022-IRB-1082.

Author Contributions: Aleena Nadeem: Design, Data Analysis.

Nimra Ayoub: Concept, Data Collection.

Muhammad Hamza Najam: Data Collection, Article Draft.

Manzra Shaheen: Data Collection, Literature Review.

Sara Iqbal: Critical Review, Data Collection.

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