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Correlation between Cataract Morphology and Postoperative Visual Acuity in Patients Undergoing Phacoemulsification

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Abstract

Introduction: For cataracts, the leading cause of reversible blindness worldwide, phacoemulsification is the preferred surgical technique. Visual results may vary based on cataract morphology, despite the lack of local evidence relating specific cataract forms to postoperative recovery.

Objective: to assess the relationship between postoperative visual acuity and cataract morphology in phacoemulsification patients.

Methodology: From January to December 2024, the Department of Ophthalmology at DHQ Hospital Kotli carried out this prospective observational study. 250 patients who were at least 40 years old and undergoing simple posterior chamber phacoemulsification Included was the implantation of intraocular lenses. Best corrected visual acuity (BCVA) and cataract grading using the Lens Opacities Classification System III (LOCS III) comprised the preoperative evaluation. At six weeks, postoperative BCVA was measured. Surgical parameters were recorded, such as phaco energy and effective phacoemulsification time (EPT). ANOVA and Pearson correlation were used to analyze the data using SPSS 26; $p<0.05$ was deemed significant.

Results: Mean age was 63.4 ± 9.2 years; 138 patients (55.2%) were male. Cataract types were nuclear (40.8%), cortical (27.2%), posterior subcapsular (PSC, 22.4%), and mixed (9.6%). Postoperative BCVA improved from 0.78 ± 0.25 to 0.12 ± 0.09

logMAR ($p<0.001$). PSC cataracts showed the greatest visual gain (0.83 ± 0.21 logMAR), while nuclear cataracts required the highest EPT and phaco energy. Overall, 87.2% achieved BCVA ≥6/12. Cataract morphology strongly correlated with visual improvement ($r=-0.63$, $p<0.001$). Complications were minimal.
Conclusion: Excellent visual recovery is possible with phacoemulsification, and cataract morphology has a major impact on the results. Surgical planning and patient counseling depend on the preoperative evaluation of cataract type.

Introduction

Cataract is the most prevalent cause of reversible blindness in the globe, and one of the greatest causes of visual impairment, especially in low- and middle-income nations [1]. It is marked by gradual opacification of the crystalline lens leading to a decline in visual acuity, reduced contrast sensitivity and poor quality of life [2]. As the lifespan and the elderly population grow, cataract-based visual disability is on the increase, creating a formidable problem to the national health and socioeconomic stakes [3]. The only sure treatment is surgical removal of the cataractous lens which has been applied in surgical procedures, and the progress of surgical procedures has significantly improved the visual outcomes after the surgery [4].

Phacoemulsification is now the gold standard cataract surgery because it is safe, minimally invasive, intellectually quicker in recovery, and also excelled much better in visual rehabilitation than extracapsular cataract extraction [5]. Although the entire phacoemulsification process has been successful, the final results of the operation in terms of visual results may differ significantly between individuals [6]. Some of the factors that affect the outcomes include the age of the patient, comorbidities of the eyes, the method by which the surgery is conducted, the choice of the intraocular lens (IOL), and the preoperative nature of the cataract itself [7]. Of these, the morphology of cataracts is significant in the determination of the complexity of the surgery procedure and the visual prognosis after the surgery [8].

Cataracts are generally categorized by location and morphological features according to their anatomy and morphology as nuclear, cortical, posterior subcapsular (PSC), and mixed types [9]. Both morphologies have different effects on vision and present special surgical challenges [10]. The effects of nuclear cataracts typically include slow loss of vision and myopia, cortex cataracts are typically glare producing and variable sight, and PSC cataracts, even relatively small ones can be a major impediment to near vision and cause visual symptoms of disproportional impact even in bright light [11]. These morphological variations affect the phacoemulsification energy needs, effective phacoemulsification time (EPT), loss of endothelial cells, intraoperative complications, and postoperative visual recovery [7].

Earlier research has also indicated that thicker cataracts, especially those of the nuclear kind, demand more ultrasound energy and are more time consuming to operate which can raise the chances of postoperative inflammation or corneal edema, which can culminate into the visual results [12]. On the other hand, PSC cataracts tend to show significant postoperative outcome because of the extent of visual impairment it preoperative presents [13]. To typically categorize the type and degree of cataract, cataract grading systems systematically to understand their predictive significance of particular morphologies on visual recovery following the operation have been adopted, e.g. the Lens Opacities Classification System III (LOCS III) [14].

Although phacoemulsification is widely used, local data on how morphology of the cataracts is correlated with visual outcome post-operative is not abundant. This research was hence developed in order to assess the correlation between the various cataract typologies and the postoperative visual acuity in individuals undergoing

phacoemulsification and give context specific evidence to assist surgical planning, patient counseling and expectation management.

Methodology

This is a proposed observational study, which was carried out in the Department of Ophthalmology, District Headquarters (DHQ) Hospital, Kotli. The timeframe of the study was 12 months, 1st January 2024-31st December 2024. The research was conducted as per the Declaration of Helsinki, and the institutional review committee of DHQ Hospital, Kotli gave the research ethical approval. All participants were enrolled with the written informed consent.

Study Population and Sampling Technique: The patients diagnosed with senile cataract and planned to have phacoemulsification and posterior chamber intraocular lens (PCIOL) implantation were consecutively recruited by a non-probability consecutive sampling method. The patients were both male and female with the age of 40 years and older.

Inclusion and Exclusion Criteria: all patients who had a visually significant cataract of any variety (nuclear, cortical, posterior subcapsular, or mixed) and underwent an uncomplicated phacoemulsification procedure were included. Those patients who had pre-existing ocular comorbidities (glaucoma, diabetic retinopathy, age-related macular degeneration, corneal opacities, uveitis, or prior ocular surgery) were excluded. Also, patients that had any intraoperative or postoperative complication (e.g. anterior capsular rupture, severe corneal edema) which might influence visual acuity by itself were not included in final analysis.

Sample Size Calculation: This study used the World Health Organization (WHO) formula to estimate a single population proportion [15]: $n = \frac{Z^2 p \cdot (1-p)}{d^2}$ with n being the sample size needed, Z is the standard normal deviate of the 95% confidence interval (1.96) and p is the prevalence which is estimated (0.805) [16] and d is the margin of error (0.05). Using this formula, the sample size was determined to be 241 patients as the lowest possible sample size. The final sample size of 250 patients was considered in the study to consider the possibility of dropouts and failure of follow-ups.

Preoperative Assessment: The patients were evaluated in preoperative thoroughly before being assigned to the variation patient program where demographic data, medical history, and ocular examination were recorded. Best corrected visual acuity (BCVA) was measured using a Snellen chart and then converted into units of logarithm of the minimum angle of resolution (logMAR) to effect a statistical analysis. Slit-lamp biomicroscopy was conducted in order to determine the morphology and grade of cataracts. The slit-lamp findings of the clinical observation classified cataracts in several categories such as nuclear, cortical, posterior subcapsular or mixed and grading was done using the Lens Opacities Classification System III (LOCS III). Measurement of intraocular pressure was done using goldmann applanation tonometry and where possible, assessment of the posterior segment using indirect ophthalmoscopy. Intraocular lens power calculations were done by biometry either with optical or ultrasound.

Surgical Procedure: All the surgeries were done under local anesthesia and standard phacoemulsification procedure of the experienced consultant ophthalmologists. A sharp corneal incision was performed, and progressive curvilinear capsulorhexis,

hydrodissection, phacoemulsification of nucleus, cortical aspiration and implantation of a foldable intraocular lens of the anterior chamber in the bag of the capsule were performed. After the surgery, every patient was offered a unified treatment of topical antibiotics and corticosteroids.

Postoperative Assessment: postoperative outcomes were followed up on day 1, after 1 week and 6 weeks. The main outcome measure was best corrected visual acuity in 6 weeks after the operation. At every visit, slit-lamp examination was conducted to determine the clarity of the cornea, anterior chamber reaction and the position of the IOL. Any complications after the operation were reported.

Data Analysis: Data were inputted and analyzed with the help of version 26 of SPSS. Quantitative variables e.g. age and visual acuity were provided as mean ± standard deviation whereas qualitative variables e.g. gender and cataract morphology were provided as frequencies and percentages. Appropriate statistical tests, such as one-way ANOVA or Chi-square test were used to evaluate the correlation between the cataract morphology and the postoperative visual acuity with p less than 0.05 regarded as a statistically significant value.

Results

The number of patients participating in this study was 250 patients undergoing phacoemulsification. Figure 1 also shows that age of the participants was mean age 63.4 ±9.2 range (42-85) , with the highest percentage (43.2%) in the 60-69 years age bracket. Of these, 138 (55.2%) were male and 112 (44.8%) were female. Preoperative best corrected visual acuity (BCVA) ranged from 6/60 to 6/18, with a mean logMAR of 0.78 ± 0.25; 31.2% of patients had vision worse than 6/36. Cataract morphology distribution was nuclear 102 (40.8%), cortical 68 (27.2%), posterior subcapsular 56 (22.4%), and mixed 24 (9.6%). Laterality of the operated eye was nearly equal, with 132 (52.8%) right eyes and 118 (47.2%) left eyes. Overall, nuclear cataracts were the most prevalent, and the demographic profile indicated a slight male predominance with moderate to severe visual impairment preoperatively.

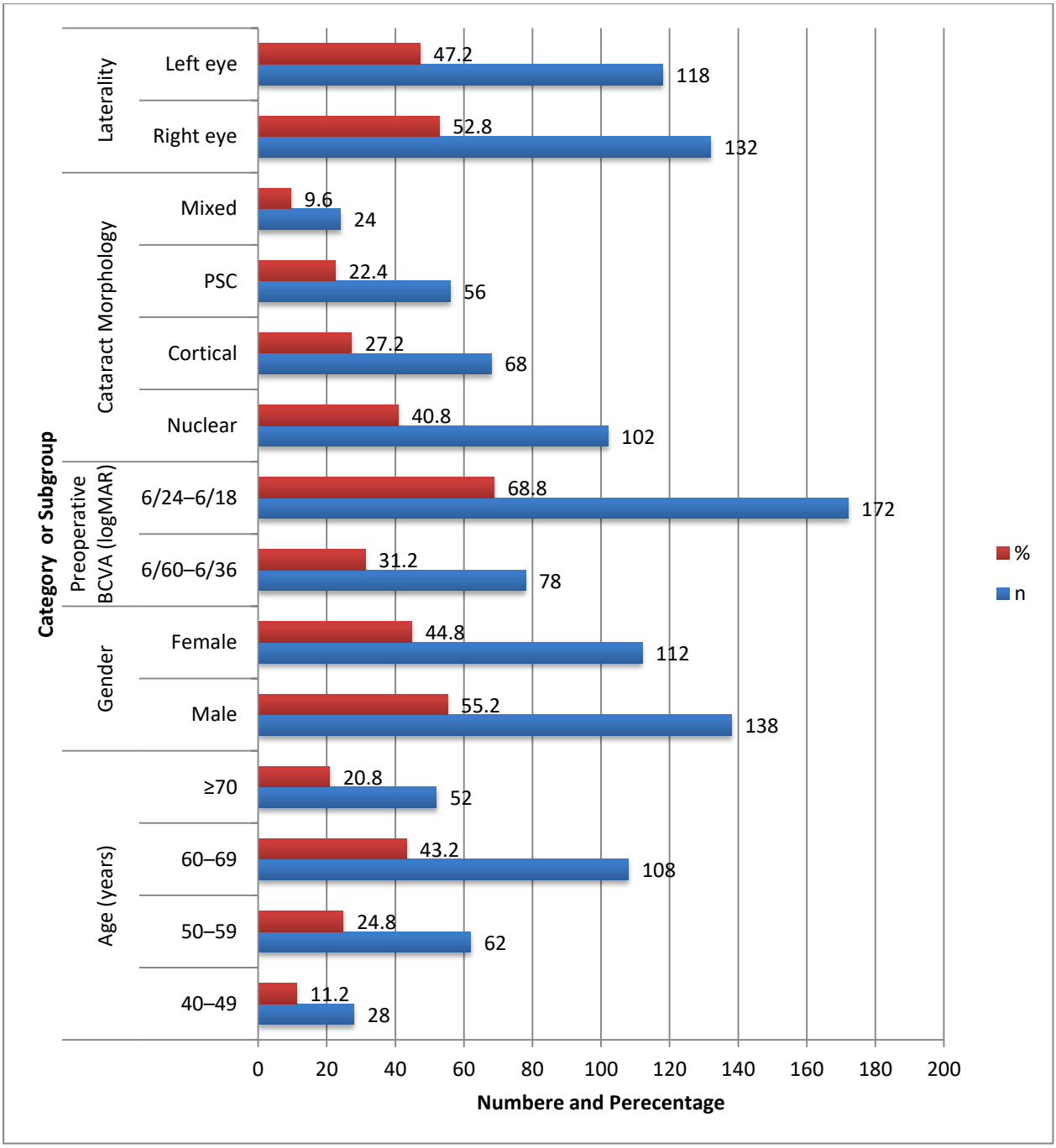

Figure 1: Demographic and Preoperative Characteristics of Patients

Legend: BCVA = Best Corrected Visual Acuity; logMAR = Logarithm of the Minimum Angle of Resolution; PSC = Posterior Subcapsular Cataract.
Nuclear cataracts required the highest effective phacoemulsification time (43.5 ± 8.2 s) and phaco energy (78.3 ± 12.5%), while posterior subcapsular cataracts required the least time (21.3 ± 5.1 s) and energy (41.2 ± 8.4%). Cortical and mixed cataracts had intermediate surgical requirements. As shown in Table 1, Mean nuclear density was highest in nuclear cataracts (3.2 ± 0.7) and lowest in PSC (2.1 ± 0.5). Mean incision sizes were similar across all morphologies (2.6–2.8 mm). One-way ANOVA demonstrated a statistically significant difference in EPT among cataract types ($F=142.3$, $p<0.001$), indicating that denser cataracts are associated with increased surgical complexity and energy requirements.

Table 1: Cataract Morphology vs. Surgical Parameters

Morphology	n	Mean Nuclear Density (LOCS III) ± SD	Mean EPT (s) ± SD	Mean Phaco Energy (%) ± SD	Mean Incision Size (mm) ± SD
Nuclear	102	3.2 ± 0.7	43.5 ± 8.2	78.3 ± 12.5	2.8 ± 0.2
Cortical	68	2.5 ± 0.6	29.8 ± 6.5	54.6 ± 10.2	2.7 ± 0.2
PSC	56	2.1 ± 0.5	21.3 ± 5.1	41.2 ± 8.4	2.6 ± 0.2
Mixed	24	3.0 ± 0.6	37.6 ± 7.4	66.1 ± 11.7	2.8 ± 0.3
Total	250	2.8 ± 0.7	34.2 ± 11.6	60.7 ± 17.8	2.7 ± 0.2

Legend: EPT = Effective Phacoemulsification Time; LOCS III = Lens Opacities Classification System III; PSC = Posterior Subcapsular Cataract.

There was a significant improvement in the postoperative visual acuity in all cataract morphologies with mean. BCVA improved with a preoperative level of 0.78 ± 0.25 logMAR to 0.12 ± 0.09 logMAR. after surgery (paired t-test, t=42.7, p<0.001). As illustrated, in Table 2, Posterior subcapsular The largest mean change was shown by cataracts (0.83 ± 0.21 logMAR) and then. nuclear (0.65±0.19), mixed (0.61 +- 0.18) and cortical cataracts (0.58 ±0.16). A total of 218 the proportion of patients (87.2%) having a postoperative BCVA of ≥ 6/12 was highest in PSC. cataracts (94.6%) and lowest in mixed cataracts (83.3) respectively. Patients whose cataracts are not dense were generally less phaco energy consuming and had a little less visual gain. These findings show that, there is a strong relationship between cataract morphology and postoperative visual improvement.

Table 2: Postoperative Visual Acuity According to Cataract Morphology

Morphology	n	Preop BCVA (logMAR) ± SD	Postop BCVA (logMAR) ± SD	Mean Improvement ± SD	Patients with ≥6/12 (%)	Patients with <6/12 (%)
Nuclear	102	0.81 ± 0.24	0.16 ± 0.10	0.65 ± 0.19	87 (85.3%)	15 (14.7%)
Cortical	68	0.76 ± 0.21	0.18 ± 0.09	0.58 ± 0.16	58 (85.3%)	10 (14.7%)
PSC	56	0.84 ± 0.25	0.01 ± 0.05	0.83 ± 0.21	53 (94.6%)	3 (5.4%)
Mixed	24	0.79 ± 0.22	0.18 ± 0.08	0.61 ± 0.18	20 (83.3%)	4 (16.7%)
Total	250	0.78 ± 0.25	0.12 ± 0.09	0.66 ± 0.21	218 (87.2%)	32 (12.8%)

Legend: BCVA = Best Corrected Visual Acuity; logMAR = Logarithm of the Minimum Angle of Resolution; PSC = Posterior Subcapsular Cataract.

As illustrated in Figure 2, the evaluation of achievement of a at 6 weeks postoperative showed that most of the patients (87.2%) attained. BCVA 6/12 or higher and 95 patients (38.0%) had ≥6/6, 78 (31.2%) achieving 6/9, and 45 (18.0%) achieving 6/12. Only 22 patients (8.8%) had BCVA of 6/18 and 10 patients (4.0%) had vision worse than 6/18, mostly because of pre-existing retinal. pathology. These findings verify the

effectiveness of phacoemulsification is high in the restoration of functional vision in various cataract morphologies.

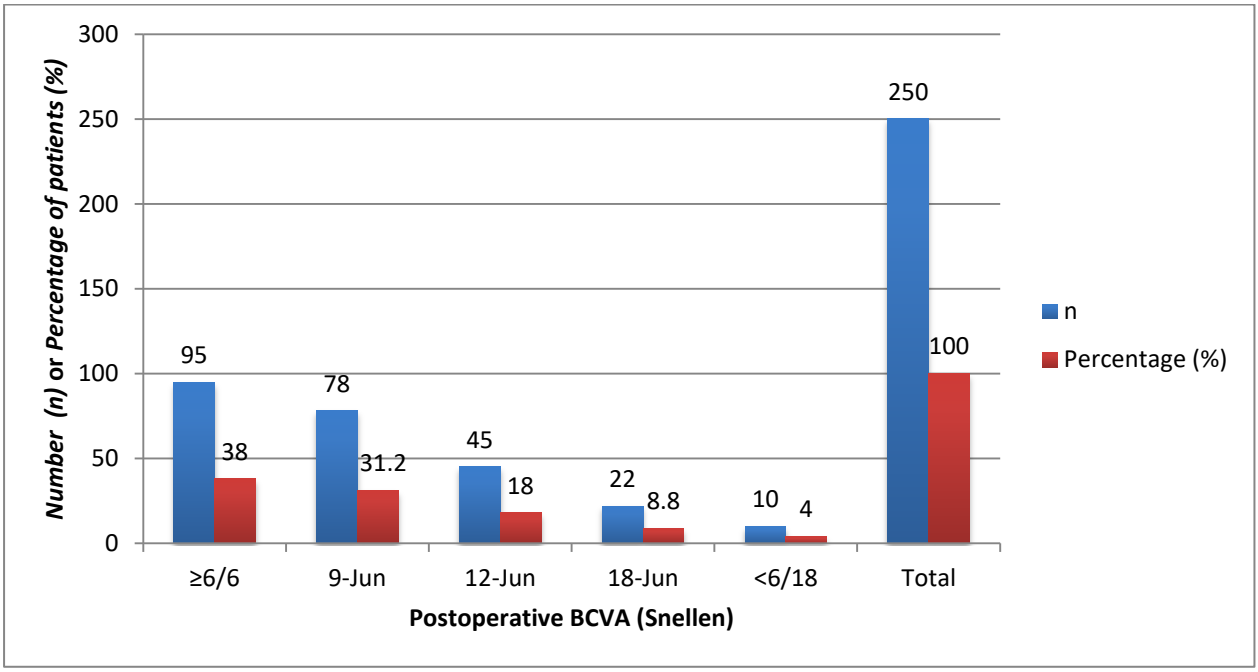

Figure 2: Distribution of Postoperative Visual Acuity at 6 Weeks
Legend: BCVA = Best Corrected Visual Acuity.

Postoperative complications were few and most of them mild in nature with 209 patients (83.6%). not having any negative experiences. Corneal edema was most frequently present as in Table 3. complication, which occurred in 19 patients (7.6%), which was treated using topical steroids and lubricants, subsequently, mild anterior chamber reaction occurred in 12 patients (4.8%) who were treated with topical steroids. In 5 patients (2.0%), it was found to develop a posterior capsular opacification, which was treated conservatively. or using potential YAG capsulotomy and intraocular lens (IOL) decentration was in 2. patients (0.8%) that needed some slight adjustment. Other minor (1.2%) was experienced by three patients. complications that are treated in a non-invasive manner. None of the serious side effects, including endophthalmitis, were present reported, the safety of phacoemulsification in expert hands is reflected

Table 3: Postoperative Complications

Complication	**n**	**Percentage (%)**	**Severity**	**Management**
Corneal edema	19	7.6	Mild	Topical steroids & lubricants
Anterior chamber reaction	12	4.8	Mild	Topical steroids
Posterior capsular opacification	5	2.0	Mild	Observation / potential YAG capsulotomy
IOL decentration	2	0.8	Mild	Observation / minor adjustment
Others (minor)	3	1.2	Mild	Conservative management
None	209	83.6		

Legend: IOL = Intraocular Lens; YAG = Yttrium-Aluminum-Garnet laser.

The correlation analysis demonstrated that the morphology of the cataracts was strongly related to the negative ($r = -0.63$, $p < 0.001$) and depended on the denser or more significant cataracts towards the side of the retina like posterior subcapsular type of cataracts, which were associated with higher postoperative visual gains as indicated by the correlation coefficient in Table 4. Moderate negative correlations with visual outcomes were also present between effectual phacoemulsification time (EPT) and phaco energy ($r = -0.52$ and -0.48, respectively; $p < 0.001$), with more operation energy needed to treat denser cataracts. Age was also positively correlated with postoperative BCVA with a weak correlation ($r = 0.21$, $p < 0.001$) but the correlation between preoperative and postoperative BCVA was strong ($r = -0.67$, $p < 0.001$). These results indicate that cataract morphology and visual preoperative status is an important predictor of postoperative visual outcome.

Table 4: Correlation Between Cataract Morphology, EPT, and Postoperative Visual Acuity

Variable	r	p-value	Interpretation
Cataract morphology vs. BCVA	-0.63	<0.001	Strong negative correlation
EPT vs. BCVA	-0.52	<0.001	Moderate negative correlation
Phaco energy vs. BCVA	-0.48	<0.001	Moderate negative correlation
Age vs. BCVA	0.21	0.001	Weak positive correlation
Preop BCVA vs. Postop BCVA	-0.67	<0.001	Strong negative correlation

Legend: BCVA = Best Corrected Visual Acuity; EPT = Effective Phacoemulsification Time.

Discussion

In this research, the researcher investigated the relationship between cataract morphology and postoperative visual acuity in 250 patients undergoing phacoemulsification. The outcomes proved the significant improvement of the visual outcomes in all types of cataracts with the highest level of the mean improvement in the posterior subcapsular cataracts. The most energy and time in phacoemulsification were essential in nuclear cataracts as compared to cortical and PSC cataracts which were not surgically challenging. In general, 87.2 percent of patients had postoperative BCVA of 6/12 or higher and complications were minor which proved the safety and effectiveness of current phacoemulsification methods. The analysis showed that there was a significant negative relationship between the cataract morphology and postoperative visual improvement hence patients with larger cataract preoperative tended to record higher visual improvement.

When compared with existing literature, the findings of this study are consistent with prior observations that posterior subcapsular cataracts, despite smaller size, often cause disproportionately severe visual impairment preoperatively and thus exhibit greater postoperative improvement [10]. Nuclear cataracts, particularly those with higher density grades, require longer phacoemulsification times and higher ultrasound energy, which is in line with reports highlighting increased surgical complexity and risk of corneal endothelial cell loss in dense nuclei [17]. The overall rate of patients achieving BCVA $\geq$6/12 in this study is comparable to the outcomes reported in similar phacoemulsification series, demonstrating high effectiveness of the procedure in restoring functional vision [18]. The low incidence of postoperative complications such as corneal edema, anterior chamber reaction, and posterior capsular opacification is consistent with contemporary surgical safety standards [19]. Furthermore, the

observed correlations between surgical parameters (EPT, phaco energy) and visual outcomes support the concept that denser cataracts pose greater intraoperative challenges but do not significantly compromise ultimate visual recovery when surgery is performed skillfully [20].

This study also emphasizes the importance of preoperative assessment of cataract morphology for patient counseling and surgical planning [21]. Accurate grading of cataract type allows surgeons to anticipate potential difficulties, optimize phacoemulsification parameters, and manage postoperative expectations effectively [22]. Additionally, the data suggest that patients with posterior subcapsular or mixed cataracts may benefit from earlier surgical intervention, given their higher potential for visual gain [23].

The results of the research are aligned with the previous implications that have been described in the literature and that the posterior subcapsular cataracts though smaller in size have a tendency to lead to disproportionately high preoperative visual impairment and, therefore, have more significant postoperative improvement in comparison to the other types of cataracts [10]. Nuclear cataracts, especially those of higher density grades necessitate a longer phacoemulsification duration and elevated ultrasound energy and this is consistent with surgical complexities and corneal endothelial cell loss reports were reported to be higher in dense nuclei [17].

The percentage of patients, whose BCVA $\geq$ 6/12 in this study is also similar to the results of other phacoemulsification series, indicating high success of the process in restoring normal vision [18]. The few cases of postoperative complications, including corneal edema, anterior chamber reaction, and posterior capsular opacification, are in line with the current safety standards in surgery [19]. Moreover, the noted relationships between the characteristics of surgery (EPT, phaco energy) and the quality of visual results confirm the idea that denser cataracts represent more difficult situations to control during surgery but do not have any significant effects on the final visual outcomes when surgery is done professionally [20].

Another important point in this study is that cataract morphology should be preoperatively assessed to provide counseling to patients and to plan surgery [21]. Proper classification of the type of cataract enables the surgeon to predict possible complications, to manipulate the phacoemulsification operation, and to adequately regulate the expectations of the postoperative period [22]. Also, there is some evidence that earlier surgery may reach a superior outcome with patients with posterior subcapsular or mixed cataracts as they have higher visual gain potential [23].

Limitations and Future Suggestions: The research was performed at a single tertiary care hospital, which might not be applicable to the rest of the world. The follow-up time was only 6 weeks, and no long-term visual results and complications were measured. Future multicenter research, better sample sizes, and longer follow-ups are suggested to confirm these results as well as to measure endothelial cell loss, the patient-reported visual satisfaction, and quality-of-life outcomes. In addition, further introduction of novel imaging modalities of objective cataract density can also be used to improve the predictive models of visual recovery after operation.

Conclusion

Phacoemulsification is a very effective and safe technique of restoring the sight in senile cataract patients. Cataract morphology plays a significant role in the improvement of visual outcomes in the postoperative period, with anterior subcapsular cataracts exhibiting the most visual improvement and nuclear cataracts taking more phacoemulsification energy and time. Generally, most of the patients made a full recovery with little complications. These results highlight the necessity to preoperatively evaluate the type of cataract to be operated on in the planning of

surgery and counseling of the patient to support the use of individualized strategies to maximize the postoperative visual results.

References

Vision Loss Expert Group of the Global Burden of Disease Study. Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020. Eye. 2024 Mar 9;38(11):2156. https://doi.org/10.1038/s41433-024-02961-1

AlRyalat SA, Atieh D, AlHabashneh A, Hassouneh M, Toukan R, Alawamleh R, Alshammari T, Abu-Ameerh M. Predictors of visual acuity improvement after phacoemulsification cataract surgery. Frontiers in Medicine. 2022 Sep 21;9:894541.https://doi.org/10.3389/fmed.2022.894541

Wan Z, Bai J, Wang W, Peng Q. Global, regional, and national burden of cataract among older adults from 1990 to 2021: a comprehensive analysis based on the global burden of disease study 2021. Frontiers in Medicine. 2025 Sep 4;12:1679828. https://doi.org/10.3389/fmed.2025.1679828

Sa'at N, Ghazali AK, Yaacob NM, Salowi MA. Factors influencing visual improvement after phacoemulsification surgery among Malaysian cataract patients. International Journal of Environmental Research and Public Health. 2022 Sep 13;19(18):11485. https://doi.org/10.3390/ijerph191811485

Li A, He Q, Wei L, Chen Y, He S, Zhang Q, Yan Y. Comparison of visual acuity between phacoemulsification and extracapsular cataract extraction: a systematic review and meta-analysis. Annals of Palliative Medicine. 2022 Feb;11(2):55159-559. doi: 10.21037/apm-21-3633

Fortunata F, Firmansjah M. Overview of visual acuity improvement in postoperative cataract patients using a monofocal lens and phacoemulsification techniques: Visual acuity in post cataract surgery patients. Surabaya Medical Journal. 2024 May 31:41-8.https://orcid.org/0009-0001-2574-0502

Mackenbrock LH, Baur ID, Łabuz G, Auffarth GU, Khoramnia R. Impact of phacoemulsification parameters on central retinal thickness change following cataract surgery. Diagnostics. 2023 Sep 4;13(17):2856.https://doi.org/10.3390/diagnostics13172856

Ciorba AL, Teusdea A, Roiu G, Cavalu DS. Particularities of cataract surgery in elderly patients: corneal structure and endothelial morphological changes after phacoemulsification. Geriatrics. 2024 Jun 8;9(3):77.https://doi.org/10.3390/geriatrics9030077

Abbas H, Rauf A, Perveen S, Mehmood SH, Hussain I, Naimat K. The association of cataract type on central corneal thickness after phacoemulsification cataract surgery. PAFMJ. 2021 Oct 1;71:1611-4. https://pafmj.org/index.php/PAFMJ/article/download/6856/3585

Aswin PR, Harika K, Shekhar M, Sankarananthan R, Shah A, Lakshmanan P, Aravind H. Morphological variations influencing the outcomes in posterior polar cataract. Indian Journal of Ophthalmology. 2022 Jul 1;70(7):2426-31.DOI: 10.4103/ijo.IJO_2764_21

Feng L, Zhao F, Ke X, Zhao J, Shi M. Correlation between degree of lens opacity and the phacoemulsification energy parameters using different imaging methods in age-related cataract. Translational Vision Science & Technology. 2022 Mar 2;11(3):24-.https://doi.org/10.1167/tvst.11.3.24

Gull A, Janjua MI, Imdad T. Central Corneal Thickness and Intraocular Pressure Changes After Phacoemulsification and Their Association with Cataract Density. Pakistan Journal of Ophthalmology. 2025 Sep 30;41(4).https://doi.org/10.36351/pjo.v41i4.2147

Lee NS, Ong K. Changes in refraction after cataract phacoemulsification surgery. International Ophthalmology. 2023 May;43(5):1545-51.https://doi.org/10.1007/s10792-022-02550-9

Tian Y, Li Q. Macular foveal retinal and choroidal thickness changes after phacoemulsification in high myopia cataract patients. Medicine. 2025 Sep 19;104(38):e44450.DOI: 10.1097/MD.0000000000044450

Lwanga SK, Lemeshow S. Geneva: World Health Organization; 1991. Sample size determination in health studies: a practical manual. 2022:80.

Hashmi FK, Khan QA, Chaudhry TA, Ahmad K. Visual outcome of cataract surgery. J Coll Physicians Surg Pak. 2013;23(6):448. https://ecommons.aku.edu/cgi/viewcontent.cgi?article=1356&context=pakistan_fhs_mc_surg_surg

Ordiñaga-Monreal E, Castanera-Gratacós D, Castanera F, Fambuena-Muedra I, Vega F, Millán MS. Pupil size differences between female and male patients after cataract surgery. Journal of optometry. 2022 Apr 1;15(2):179-85.https://doi.org/10.1016/j.optom.2020.09.005

Perone JM, Luc MS, Zevering Y, Vermion JC, Gan G, Goetz C. Narrative review after post-hoc trial analysis of factors that predict corneal endothelial cell loss after phacoemulsification: Tips for improving cataract surgery research. Plos one. 2024 Mar 21;19(3):e0298795.https://doi.org/10.1371/journal.pone.0298795

Shetty V, Deshpande N, Deshpande P, Choubisa J, Chavan A, Shaji A, John S, Pradhan A, Setia MS. Postoperative Rotation and Refractive Efficacy of Toric Intraocular Lenses After Phacoemulsification Cataract Surgery. Ophthalmology and Therapy. 2025 Oct;14(10):2415-32.https://doi.org/10.1007/s40123-025-01207-x

Shaheen MS, AbouSamra A, Helaly HA, Said A, Elmassry A. Comparison between refractive outcomes of femtosecond laser-assisted cataract surgery and standard phacoemulsification. BMC ophthalmology. 2020 Jan 2;20(1):1.https://doi.org/10.1186/s12886-019-1277-9

Icoz M, Gurturk Icoz SG. Importance of optical coherence tomography before cataract surgery. BMC ophthalmology. 2024 Aug 12;24(1):339.https://doi.org/10.1186/s12886-024-03622-3

Sangeetha A, Raviraj K, Kumaresan M, Priyanka G. Importance of Grading Cataracts in Predicting Recovery Time and Final Visual Outcomes After Cataract Surgery. Cureus. 2024 Sep 13;16(9).https://doi.org/10.7759/cureus.69309

Farquhar E, Harley U, Rotchford A, Ramaesh K. Should we perform early cataract surgery? A patient reported outcome study. Clinical Ophthalmology. 2021 Dec 16:4707-14.https://doi.org/10.2147/OPTH.S323348