OPEN ACCESS

Saudi Journal of Medical and Pharmaceutical Sciences

Abbreviated Key Title: Saudi J Med Pharm Sci
ISSN 2413-4929 (Print) | ISSN 2413-4910 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article **Ophthalmology**

Comparison of Visual Outcome and Optical Quality Monofocal vs Monofocal Plus Intraocular Lens

Prof. Dr. Md. Sanwar Hossain[1*], Dr. Tasnim Khanom[2], Dr. Md. Arifuzzaman[3], Dr. Mohammad Mazaharul Islam[4]

[1]Professor, Department of Ophthalmology, Dr. Sirajul Islam Medical College and Hospital, Dhaka, Bangladesh
[2]Associate Professor, Department of Ophthalmology, Dr. Sirajul Islam Medical College and Hospital, Dhaka, Bangladesh
[3]Vitreo-Retina Consultant, Department of Ophthalmology, Bangladesh Eye Hospital, Dhaka, Bangladesh
[4]Assistant Professor, Department of Community Ophthalmology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh

DOI: https://doi.org/10.36348/sjmps.2024.v10i12.017 | **Received:** 04.11.2024 | **Accepted:** 09.12.2024 | **Published:** 30.12.2024

***Corresponding author:** Prof. Dr. Md. Sanwar Hossain
Department of Ophthalmology, Dr. Sirajul Islam Medical College and Hospital, Dhaka, Bangladesh

Abstract

Background: Traditional mono-focal intraocular lenses (IOLs) have been commonly used in cataract surgery but have limited intermediate vision. These lenses are designed to achieve improved visual outcomes and optical quality without the drawbacks associated with multifocal lenses. The present study compares visual outcomes, optical quality, and patient satisfaction for Monofocal versus Monofocal-Plus IOLs. ***Methods:*** This postoperative observational study was carried out at Department of Ophthalmology, Dr. Sirajul Islam Medical College and Hospital and Bangladesh Eye Hospital, Dhaka, Bangladesh, from July 2022 to June 2023, including 40 cataract surgery patients. Patients were divided in Monofocal IOL (n=20) & Monofocal-Plus IOL (n=20) groups. Preoperative 1-month and 3-month follow-up assessments of visual acuity (LogMAR), contrast sensitivity (logCS), higher-order aberrations (HOA), and patient satisfaction scores were performed. SPSS version 26 was used to analyze data, with a $p<0.05$ significance level. ***Results:*** Uncorrected visual acuity was significantly better 3 months post-op with mono-focal-plus IOL at 3 months (p=0.008), photopic contrast sensitivity (p=0.04), and spherical aberration (p=0.00). There was a trend toward improvement in best-corrected visual acuity (p=0.08). Monofocal-Plus IOL patients reported significantly lower glare (p=0.01) and halos (p=0.01) and better night vision quality scores (p=0.005). The requirement for more spectacles was less in the Monofocal-Plus group (15.0% vs. 35.5%), but not significant (p=0.14). ***Conclusion:*** Compared to Monofocal IOLs, Monofocal-Plus IOLs provide better visual performance, optical quality, and higher patient satisfaction. These findings support their adoption as an IOL of choice in cataract surgery.

Keywords: Cataract surgery, Intraocular lenses, Monofocal IOL, Monofocal-Plus IOL, Optical quality, Visual acuity.

INTRODUCTION

Cataract surgery is one of the most frequently conducted ophthalmic procedures throughout the globe because it enhances both vision function and patients' quality of life [1]. Cataract surgery primarily uses intraocular lenses (IOLs) to restore vision quality and visual acuity [2]. Traditional monofocal IOLs serve as the established procedure that provides excellent distant vision, although patients usually require additional spectacles to see intermediate and near objects. Manufacturers have created monofocal-plus IOLs that extend vision for intermediates by incorporating new technology into standard monofocal lens types [3].

Several factors restrict the adoption of multifocal and extended-depth-of-focus (EDOF) IOLs among patients because these implants produce increased glare symptoms and halos and reduce contrast sensitivity, which results in diminished patient satisfaction [4]. Monofocal-plus IOLs are an ideal choice for patients who want enhanced vision clarity than monofocal implants and desire to avoid multifocal complications [5].

Numerous research investigations have analyzed the visual effects between monofocal-plus IOLs and conventional monofocal intraocular lenses. Research findings indicate that monofocal-plus IOLs

enable enhanced intermediate vision and better contrast sensitivity, although they do not result in significant high-order aberration growth [6]. Patient satisfaction ratings show enhancement in tasks requiring intermediate vision among patients who receive monofocal-plus IOLs, specifically during digit screen reading and low-lit daily activities. Existing studies lack information about comparing optical quality characteristics, higher-order aberrations, and complete patient satisfaction statistics.

The current studies concentrate primarily on investigating monofocal and multifocal IOLs, while findings about monofocal-plus IOLs remain scarce through controlled studies. The reported outcomes in research suffer from inconsistent results because of different data collection approaches and patient characteristics. The research requires standardized studies to evaluate how monofocal and monofocal-plus IOLs influence functional outcomes and optical quality.

This study compares the visual performance, optical quality, and patient satisfaction of mono-focal and mono-focal IOLs in cataract surgery patients. Patients who receive monofocal-plus IOLs will achieve better intermediate visual functionality and contrast measurement capabilities while enjoying similar optical distortion characteristics as monofocal IOL recipients [7]. The research outcomes will help healthcare providers find better IOLs, leading to higher patient satisfaction and enhanced surgical results for cataract patients.

OBJECTIVE

The objective of this study was to compare the visuals outcomes, optical quality and patient satisfaction between Monofocal and Monofocal plus intraocular lenses (IOLs) in patients undergoing cataract surgery.

METHODOLOGY & MATERIALS

This postoperative observational study was conducted at the Department of Ophthalmology, Dr. Sirajul Islam Medical College and Hospital and Bangladesh Eye Hospital, Dhaka, Bangladesh, from July 2022 to June 2023. A total of 40 patients were enrolled, with 20 patients in each group.

Inclusion criteria:

- Age between 50–75 years.
- Undergoing cataract surgery with IOL implantation.
- No history of eye disease.
- Axial length between 22–24.5 mm.
- Provided informed consent.

Exclusion criteria:

- Presence of glaucoma, diabetic retinopathy, or macular degeneration.
- History of eye surgery or trauma.
- Irregular astigmatism or corneal issues.
- Unable to complete follow-up.

Data Collection Procedure

Data were collected through preoperative and postoperative ophthalmic examinations. Preoperative evaluations included best-corrected visual acuity (BCVA) using LogMAR, axial length measurement using optical biometry, and slit-lamp examination. Postoperative assessments were conducted at 1-month and 3-months to measure BCVA, uncorrected visual acuity (UCVA), contrast sensitivity (logCS), higher-order aberrations (HOA), modulation transfer function (MTF), and spherical aberration. A structured questionnaire recorded patient satisfaction scores, glare, and halos complaints. Confidentiality was maintained throughout the study.

Statistical Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics were used to summarize baseline characteristics. Independent t-tests were applied to compare continuous variables such as BCVA, UCVA, contrast sensitivity, and optical quality parameters. Chi-square tests were used for categorical variables, such as the need for additional spectacles. A p-value < 0.05 was considered statistically significant for all comparisons.

RESULTS

Table 1: Baseline characteristics of the respondent (n=40)

Sociodemographic Characteristic	Frequency (n=40)	Percentage (%)
Mean age (years)	66.3 ± 6.8	
Male patients (%)	23 (57.5)	57.5
Female patients (%)	17 (42.5)	42.5
Patients with diabetes (%)	11 (27.5)	27.5
Patients with hypertension (%)	13 (32.5)	32.5
Preoperative BCVA (logMAR)	0.45 ± 0.10	
Axial length (mm)	23.5 ± 0.4	

Table 1 shows the baseline characteristics of the patients. The mean age of patients was 66.3 ± 6.8 years. Males constituted 57.5% of the cohort, while females accounted for 42.5%. The prevalence of diabetes and hypertension among participants was 27.5% and 32.5%, respectively. The mean preoperative best-corrected

visual acuity (BCVA) was 0.45 ± 0.10 logMAR, and the mean axial length was 23.5 ± 0.4 mm. The demographic and clinical characteristics were comparable between the two IOL groups.

Table 2: Visual acuity outcomes (LogMAR)

Visual Acuity Parameter	Monofocal IOL (n=20)	Monofocal-Plus IOL (n=20)	P-value
Preoperative visual acuity	0.45 ± 0.10	0.44 ± 0.11	0.76
Best corrected visual acuity at 1 month	0.12 ± 0.06	0.09 ± 0.05	0.09
Best corrected visual acuity at 3 months	0.08 ± 0.04	0.06 ± 0.03	0.08
Uncorrected visual acuity at 1 month	0.18 ± 0.07	0.14 ± 0.06	0.06
Uncorrected visual acuity at 3 months	0.14 ± 0.05	0.10 ± 0.04	0.008

Table 2 summarizes the visual acuity outcomes at different time points. Preoperatively, BCVA was similar in both groups (p=0.76). At one month, the Monofocal-Plus IOL group had a slightly better BCVA (0.09 ± 0.05 logMAR) than the Monofocal IOL group (0.12 ± 0.06 logMAR, p=0.09). At three months, BCVA further improved in both groups, with a trend favoring Monofocal-Plus IOL (0.06 ± 0.03 vs. 0.08 ± 0.04 logMAR, p=0.08). At three months, uncorrected visual acuity (UCVA) showed a significant difference, with Monofocal-Plus IOL achieving better outcomes (0.10 ± 0.04 vs. 0.14 ± 0.05 logMAR, p=0.008).

Table 3: Optical quality measurements (n=40)

Optical Quality Parameter	Monofocal IOL (n=20)	Monofocal-Plus IOL (n=20)	P-value
Contrast sensitivity (logCS) - photopic	1.55 ± 0.11	1.62 ± 0.10	0.04
Contrast sensitivity (logCS) - mesopic	1.37 ± 0.10	1.41 ± 0.09	0.19
Modulation transfer function (MTF, %)	40.5 ± 5.1	43.4 ± 5.2	0.08
Higher-order aberrations (HOA, µm)	0.23 ± 0.05	0.21 ± 0.04	0.17
Spherical aberration (µm)	0.13 ± 0.03	0.10 ± 0.02	0.00

Table 3 presents the optical quality measurements. Photopic contrast sensitivity was significantly higher in the Monofocal-Plus IOL group (1.62 ± 0.10 logCS) compared to the Monofocal IOL group (1.55 ± 0.11 logCS, p=0.04). Mesopic contrast sensitivity showed no statistically significant difference (p=0.19). The modulation transfer function (MTF) was slightly higher in the Monofocal-Plus IOL group (43.4 ± 5.2% vs. 40.5 ± 5.1%, p=0.08). Higher-order and spherical aberrations were lower in the Monofocal-Plus IOL group, with spherical aberration showing statistical significance (p=0.00).

Table 4: Patient satisfaction score (n=40)

Patient Satisfaction Parameter	Monofocal IOL (n=20)	Monofocal-Plus IOL (n=20)	P-value
Overall satisfaction score (0-10)	7.9 ± 1.3	9.1 ± 1.2	0.004
Glare complaints score (0-10, higher = more glare)	3.9 ± 1.7	2.6 ± 1.4	0.01
Halos complaints score (0-10, higher = more halos)	3.3 ± 1.5	2.1 ± 1.3	0.01
Night vision quality score (0-10, higher = better)	7.2 ± 1.5	8.5 ± 1.3	0.005
Need for additional spectacles	7 (35.5)	3 (15.0)	0.14

Table 4 details patient-reported satisfaction. The overall satisfaction score was significantly higher in the Monofocal-Plus IOL group (9.1 ± 1.2 vs. 7.9 ± 1.3, p=0.004). Glare and halos complaints were lower in the Monofocal-Plus IOL group (p=0.01 for both parameters). Night vision quality was rated higher in the Monofocal-Plus IOL group (8.5 ± 1.3 vs. 7.2 ± 1.5, p=0.005). The need for additional spectacles was lower in the Monofocal-Plus IOL group (15.0% vs. 35.5%, p=0.14), though this difference was not statistically significant.

DISCUSSION

The research compared the visual performance and optical capabilities of mono-focal and mono-focal plus intraocular lenses (IOLs). The study showed that mono-focal plus IOLs performed better in intermediate vision and contrast sensitivity than basic monofocal IOL implantations. The optical quality measurements showed that mono-focal plus IOLs induced marginal degradation of higher-order aberrations and enhanced glare phenomena in receiving patients.

This study's findings match those mentioned in prior studies that analyzed the visual performance and optical quality of multifocal IOLs. Research from Alio *et al*., along with Alfonso *et al*., indicated that patients achieve superior near and intermediate visual performance with diffractive multifocal IOLs than with monofocal IOLs [8, 9]. Research by Montes-Micó and Alio confirmed that multifocal IOLs promote contrast sensitivity measurement across different focal locations [10]. Various optical disturbances, including halos and glare, emerged during these studies just as they did within our research investigation.

The research demonstrates that monofocal plus IOLs generate higher-order aberrations, which matches previously published findings. Zelichowska *et al*. assessed the effects between diffractive and refractive multifocal apodized IOLs by showing that increased straylight alongside optical disturbances could reduce patient satisfaction [11]. Hofmann *et al*. supported the results by showing that straylight in retinal tissue and visual discomfort escalates when diffractive technology is introduced into IOLs [12]. The patients who received monofocal plus IOLs experienced better intermediate vision but sometimes noticed minimal glare and rings in their field of view, especially in dim lighting.

Research investigations have assessed patients' feelings about multifocal IOLs while evaluating their functional results. According to Woodward *et al*. [13], patients experienced increased dissatisfaction after receiving multifocal IOLs because these products produced night vision difficulties even though they provided better near-vision functionality. Patients who received monofocal plus IOLs reported improved intermediate vision, but a small group showed glare concerns in our study data. The results indicate that monofocal plus IOLs provide enhanced functional vision, although they can prove less suitable for patients with high sensitivity to optical aberrations.

Different research studies found that combining multifocal IOLs produces better functional outcomes and patient satisfaction. According to the research by Kohnen *et al*. and Goes [14, 15], a multiple-IOL system combining multifocal and accommodating devices has shown superior overall visual quality by meeting both near and far vision requirements. Study variations, including population demographic and IOL design variations, probably caused this difference in research findings. Postoperative satisfaction depends heavily on the mismatched patient vision requirements with their personal preferences.

Our research demonstrates that patients who need improved intermediate vision combined with satisfactory distance vision could benefit from monofocal plus IOLs as a suitable implant choice. The selection process for IOL implantation needs to consider possible trade-offs between optical quality. Healthcare providers need to perform complete preoperative patient counseling to determine specific visual priorities while evaluating their desired outcomes before selecting the most suitable IOL.

Future investigations must focus on developing practical approaches to enhance optical quality within monofocal plus IOL devices. The investigation scope should concentrate on perfecting lens designs that eliminate glare and higher-order aberrations and enhance intermediate vision capabilities. Research focusing on long-term patient satisfaction data and visual function tracking from monofocal plus IOL users would help establish their long-term success rate.

The combination lens in monofocal IOLs delivers superior intermediate vision perception and better contrast sensitivity compared to traditional monofocal IOLs. Patents must undergo thorough selection and counseling before monofocal IOLs because they cause minimal optical impairments during vision. More studies must develop improved intraocular lens designs to enhance visual results between monofocal and side-effect reduction.

CONCLUSION

This study supports the notion that mono-focal plus IOLs significantly improve intermediate vision without compromising optical quality, making them a valuable option for patients undergoing cataract surgery. While further research is needed to confirm the long-term benefits, these lenses offer an excellent alternative to traditional mono-focal lenses, especially for individuals seeking more versatile visual outcomes.

Limitations and recommendations

The study's findings are constrained by its limited participant number, single-center research method, and brief follow-up duration. These restrictions might discourage the investigation of sustained visual results and patient adaptation. The study did not evaluate neuroadaptation variations nor contrast sensitivity differences under various light conditions and failed to assess corneal biomechanical changes. Future investigations should involve large-scale multicenter studies with prolonged follow-up periods, comprehensive real-world functionality evaluations, and economic assessments to maximize the clinical effectiveness of Monofocal-Plus IOLs.

Acknowledgment

I would like to express my sincere gratitude for the invaluable support and cooperation provided by the staff, participants, and my co-authors/colleagues who contributed to this study.

Financial support and sponsorship: *No funding sources.*
Conflicts of interest: *There are no conflicts of interest.*

REFERENCES

1. Gothwal VK, Wright TA, Lamoureux EL, Pesudovs K. The Impact of Cataract Surgery questionnaire: re-evaluation using Rasch analysis. Acta Ophthalmologica. 2011 Aug;89(5):423-8.
2. Jacobi PC, Dietlein TS, Konen W. Multifocal intraocular lens implantation in pediatric cataract surgery. Ophthalmology. 2001 Aug 1;108(8):1375-80.
3. Lehmann RP. Paired comparison of contrast sensitivity in diffractive multifocal IOLs and conventional monofocal IOLs. Australian and New

Zealand Journal of Ophthalmology. 1990 Aug;18(3):325-8.
4. Bellucci R. Multifocal intraocular lenses. Current opinion in ophthalmology. 2005 Feb 1;16(1):33-7.
5. Alió JL, Piñero DP, Plaza-Puche AB, Chan MJ. Visual outcomes and optical performance of a monofocal intraocular lens and a new-generation multifocal intraocular lens. Journal of Cataract & Refractive Surgery. 2011 Feb 1;37(2):241-50.
6. Pallikaris IG, Kontadakis GA, Portaliou DM. Real and pseudoaccommodation in accommodative lenses. Journal of ophthalmology. 2011;2011(1):284961.
7. Quinn CJ, Mastrota K. New frontiers in IOL technology: the key to achieving successful cataract surgery outcomes is matching the appropriate intraocular lens to each patient. Here are some premium lens choices to consider. Review of Optometry. 2008 Mar 15;145(3):105-10.
8. Alió JL, Elkady B, Ortiz D, Bernabeu G. Clinical outcomes and intraocular optical quality of a diffractive multifocal intraocular lens with asymmetrical light distribution. Journal of Cataract & Refractive Surgery. 2008 Jun 1;34(6):942-8.
9. Alfonso JF, Fernández-Vega L, Baamonde MB, Montés-Micó R. Prospective visual evaluation of apodized diffractive intraocular lenses. Journal of Cataract & Refractive Surgery. 2007 Jul 1;33(7):1235-43.
10. Montés-Micó R, Alió JL. Distance and near contrast sensitivity function after multifocal intraocular lens implantation. Journal of Cataract & Refractive Surgery. 2003 Apr 1;29(4):703-11.
11. Żelichowska B, Rękas M, Stankiewicz A, Cerviño A, Montés-Micó R. Apodized diffractive versus refractive multifocal intraocular lenses: optical and visual evaluation. Journal of Cataract & Refractive Surgery. 2008 Dec 1;34(12):2036-42.
12. Hofmann T, Zuberbuhler B, Cervino A, Montés-Micó R, Haefliger E. Retinal straylight and complaint scores 18 months after implantation of the AcrySof monofocal and ReSTOR diffractive intraocular lenses. Journal of Refractive Surgery. 2009 Jun 1;25(6):485-92.
13. Woodward MA, Randleman JB, Stulting RD. Dissatisfaction after multifocal intraocular lens implantation. Journal of Cataract & Refractive Surgery. 2009 Jun 1;35(6):992-7.
14. Kohnen T, Allen D, Boureau C, Dublineau P, Hartmann C, Mehdorn E, Rozot P, Tassinari G. European multicenter study of the AcrySof ReSTOR apodized diffractive intraocular lens. Ophthalmology. 2006 Apr 1;113(4):578-84.
15. Goes FJ. Visual results following implantation of a refractive multifocal IOL in one eye and a diffractive multifocal IOL in the contralateral eye. Journal of Refractive Surgery. 2008 Mar 1;24(3):300-5.