

	ORIGINAL RESEARCH PAPER VISUAL QUALITY AFTER BILATERAL IMPLANTATION OF ENHANCED MONFOCAL INTROCULAR LENS: PHOTIC PHENOMENON AND FUNCTIONAL VISUAL ASSESSMENT.	Ophthalmology KEY WORDS: Phacoemulsification; Enhanced Monofocal Intraocular Lenses; Intermediate Vision; Photic Phenomena.
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ABSTRACT	Cataract surgery has evolved significantly over recent decades, progressing from a procedure primarily aimed at restoring media transparency to one focused on achieving precise refractive outcomes. Enhanced monofocal IOLs have been developed with modifications in their optical profile to provide an extended range of vision. The present retrospective study aimed to evaluate visual quality, functional visual performance, and photic phenomena in patients who underwent bilateral implantation of enhanced monofocal intraocular lenses following uncomplicated phacoemulsification cataract surgery. Patients who underwent uneventful phacoemulsification with bilateral implantation of an enhanced monofocal intraocular lens (TECNIS Eyhance, Model ICB00) were included. Outcomes assessed at 2 weeks and 3 months postoperatively included uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), uncorrected intermediate visual acuity (UIVA at 66 cm), photic phenomena, and spectacle dependence. A total of 137 patients (mean age 63.3 ± 7.8 years) were included in the study. More than 88% of patients achieved UDVA of 6/9 or better. 98.5% of patients achieved CDVA of 6/6. And good intermediate visual acuity (≤20/25) which remained stable during follow-up. Photic phenomena were reported by 8% of patients. A higher incidence of photic disturbances was noted among younger patients (p = 0.002). Spectacle independence was high for intermediate vision (81.0%) but lower for near vision (28.5%). There were no significant gender or age based differences in visual outcomes.	
INTRODUCTION	Cataract surgery has evolved significantly over recent decades, progressing from a procedure primarily aimed at restoring media transparency to one focused on achieving precise refractive outcomes.^[1] As patient expectations for postoperative visual performance have increased, intraocular lens (IOL) technologies have advanced to provide improved functional vision. Enhanced monofocal IOLs have been developed with modifications in their optical profile to provide an extended range of vision.^[2] These lenses are designed to enhance intermediate visual performance compared with conventional monofocal lenses.^[3-5] Unlike multifocal IOLs, enhanced monofocal IOLs do not create multiple focal points and therefore generally demonstrate a lower incidence of photic phenomena such as glare, halos, and starbursts.^[5] Quality of vision is an important outcome following cataract surgery and encompasses subjective visual clarity, functional visual performance, patient satisfaction, and the presence of visual disturbances such as glare, halos, and starbursts.^[6] Evaluation of these parameters helps determine the real-world performance of newer IOL technologies. The present retrospective study aimed to evaluate visual quality, functional visual performance, and photic phenomena in patients who underwent bilateral implantation of enhanced monofocal intraocular lenses following uncomplicated phacoemulsification cataract surgery at a tertiary eye care centre.	
METHODOLOGY	Institutional ethics committee approval was obtained prior to data collection and the study adhered to the tenets of the Declaration of Helsinki. Data source included medical records including pre-operative records, operative notes and postoperative follow-up records. The study included patients who underwent uneventful phacoemulsification cataract surgery with bilateral implantation of enhanced monofocal intraocular lenses (TECNIS Eyhance IOL, Model ICB00) at Sankara Eye Hospital, Shimoga from November 2024 to November 2025.	
Inclusion Criteria:	1. Patients aged ≥ 40 years. 2. Patients who underwent uneventful phacoemulsification cataract surgery with bilateral implantation of enhanced monofocal intraocular lenses (IOLs). 3. Patients who completed postoperative follow-up at 2 weeks and 3 months. 4. Availability of complete preoperative and postoperative clinical data.	
Exclusion Criteria:	1. Pre-existing ocular comorbidities that could affect visual outcomes (e.g., glaucoma, advanced age-related macular degeneration, diabetic maculopathy, and corneal dystrophies). 2. Previous intraocular or corneal surgery. 3. Intraoperative complications (e.g., posterior capsular rupture, zonular dialysis). 4. Poor compliance with postoperative follow-up.	
Statistical Analysis	All data were analysed using Jamovi version 2.3. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables as frequencies (percentage). Independent-sample t-tests or Mann–Whitney U tests, where appropriate, were used to verify normality. Multiple logistic regression was applied to adjust for variables including photic phenomenon & spectacle dependence. A p-value < 0.05 was considered statistically significant.	
RESULTS	274 eyes of 137 patients met inclusion criteria. The study population included 62% males and 38% females with the mean age being 64.5 ± 7.3 years among male and 61.4 ± 8.3 years among female participants. The present study demonstrated stable postoperative visual acuity outcomes, with minimal variation between the 2-week and 3-month follow-up periods, indicating early stabilization of visual performance. Nearly 88% of eyes achieved 6/9 or better UDVA (uncorrected distance visual acuity), while 48.9% attained 6/6 vision. Corrected distance visual acuity (CDVA) outcomes were particularly favourable in the present study. All 274 evaluated eyes achieved 6/6 corrected vision at both 2 weeks and 3 months, demonstrating excellent postoperative optical	
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outcomes and complete stability over time.

Uncorrected intermediate visual acuity (UIVA) at 66 cm also showed stable outcomes between 2 weeks and 3 months. The majority of patients achieved 20/25 (30.9%) or 20/32 (24.4%) vision, indicating satisfactory intermediate visual performance.

Overall, the findings of the present study demonstrate excellent distance and satisfactory intermediate visual outcomes with high postoperative stability. We did not observe statistically significant differences based on sex or age, suggesting that favourable visual outcomes across different patient groups.

Table 1. Post-op Visual Outcome Right Eye and Left Eye UDVA and CDVA 2Weeks & 3 Months

Snellen Acuity	UDVA Right Eye		UDVA Left Eye		CDVA Right Eye		CDVA Left Eye	
	n	%	n	%	n	%	n	%
6/6	67	25.37	67	25.37	133	50.37	133	50.37
6/9	54	20.45	58	21.9	-	-	-	-
6/12	15	5.68	8	3.03	-	-	-	-
6/18	1	0.37	4	1.51	-	-	-	-

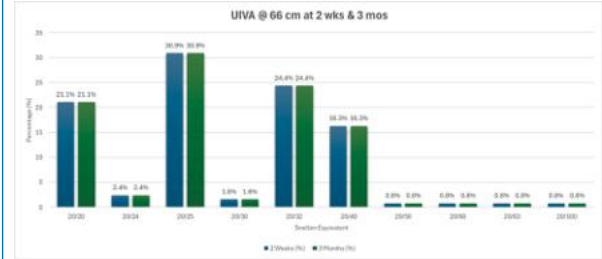


Figure 1. Post Op UIVA @66CM at 2Weeks & 3 Months

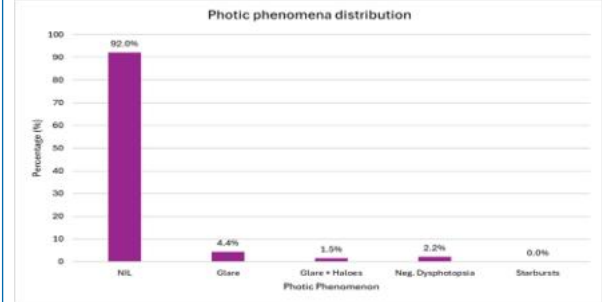


Figure 2. Photic Phenomenon and Spectacle Dependence

p-value of <0.002

DISCUSSION

The present study evaluated visual performance following bilateral implantation of enhanced monofocal intraocular lenses, with emphasis on functional vision, photic phenomena, and spectacle independence. Our results demonstrated excellent distance visual acuity with meaningful improvement in intermediate vision and a low incidence of dysphotopsia, supporting the clinical advantages of enhanced monofocal intraocular lens technology.

Conventional monofocal intraocular lenses optimize distance vision, frequently requiring postoperative spectacle correction for intermediate and near tasks. Classic descriptions of cataract surgery outcomes emphasized this limitation in functional visual range.^[1] Advances in optical engineering have introduced enhanced monofocal intraocular lenses that modify spherical aberration and optic design to increase depth of focus without employing diffractive optics.^[2-4] These lenses aim to provide improved functional vision while maintaining contrast sensitivity and

minimizing visual disturbances which are associated with multifocal lenses.

In the present study, most patients achieved good intermediate visual acuity while preserving excellent distance vision. These findings are consistent with systematic reviews and meta-analyses demonstrating superior intermediate performance of enhanced monofocal lenses compared with conventional monofocal intraocular lenses.^[3-7] Clinical studies across different populations have similarly reported improved intermediate outcomes confirming the reproducibility of these results.^[8-10]

Photic phenomena remain a major concern in modern cataract surgery. Multifocal and diffractive extended depth-of-focus lenses may induce glare and halos due to light-splitting mechanisms. Enhanced monofocal intraocular lenses employ nondiffractive optical modulation, thereby reducing dysphotopsia while extending functional depth of focus. Studies evaluating photopic phenomena and functional visual performance have reported minimal incidence of disturbing visual symptoms, findings comparable with our observations.^[5] The low frequency of photic complaints observed in our cohort supports the concept that enhanced monofocal lenses preserve visual quality while expanding visual range.

Spectacle independence is an increasingly important determinant of postoperative satisfaction. While traditional monofocal lenses typically necessitate spectacles for intermediate activities, enhanced monofocal intraocular lenses offer partial spectacle independence without compromising optical quality. Comparative studies and mini-monovision approaches have demonstrated improved independence from spectacles, particularly for intermediate visual tasks and daily functional activities.^[8-11-12] Our findings similarly indicate reduced dependence on spectacles, highlighting the functional benefit of enhanced monofocal optics in routine cataract surgery.

Enhanced monofocal intraocular lenses therefore represent an intermediate category between conventional monofocal and multifocal technologies, combining extended depth of focus with minimal dysphotopsia and high visual quality.^[4-13] The strengths of this study include bilateral implantation analysis and comprehensive functional visual assessment. Limitations include relatively short follow-up duration and lack of direct comparison with multifocal or extended depth-of-focus lenses. Future prospective randomized studies incorporating long-term patient-reported outcomes are warranted.

In conclusion, enhanced monofocal intraocular lenses provide excellent distance vision, improved intermediate visual performance, low photic phenomena, and increased spectacle independence. These characteristics make them a valuable option for patients seeking improved functional vision while maintaining high visual quality following cataract surgery.

CONCLUSION

The present study demonstrated excellent and stable postoperative visual outcomes, with most patients achieving good uncorrected distance vision and excellent corrected distance visual acuity. A high proportion (81%) achieved spectacle independence for intermediate vision, while near vision still required spectacles in many patients. The incidence of photic phenomena was low. Visual outcomes.

Conflict of Interest

None declared

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