

Visual Performance after Bilateral Implantation of Ray One EMV Intraocular Lens using Micro-Monovision Strategy

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PJO – Official Journal of
Ophthalmological Society of Pakistan



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ABSTRACT

Purpose: To examine the visual outcomes following bilateral Rayone enhanced mono-vision intraocular lens (EMV IOL) implantation.

Study Design: Retrospective chart review.

Place and Duration of Study: Al-Ehsan Welfare Eye Hospital, Lahore from January 2024 to December 2024.

Method: Twenty patients (40 eyes) who underwent bilateral Rayone EMV (enhanced monovision) IOL implantation were included. Uncorrected distance visual acuity (UCDVA) at 6 meters, intermediate visual acuity (UCIVA) at 66 cm, and near visual acuity (UCNVA) at 40cm were measured after three months of cataract surgery. Binocular defocus curve and patient-reported satisfaction were also analyzed.

Results: The mean age was 53.9 ± 4.5 years, with 65% males. After 3 months of IOL implantation, 90% of patients achieved UCDVA of 0.10 log MAR or better, with 70% reaching 0.00 (20/20). Ninety percent had UCIVA of 0.00 log Mar or better. The defocus curve in both eyes showed a smooth functional vision from distance through -2.50D, reflecting strong performance across the visual range. In 75% of patients, spectacle independence was attained, with occasional near vision aid required in a minority. Reports of glare and halos were minimal. Patient satisfaction had mean score of 9.2/10).

Conclusion: Bilateral Rayone EMVIOL implantation with a micro-monovision strategy achieved excellent near, intermediate, and distance vision with high level of spectacle independence and minimal disturbances.

Keywords: Monovision, Visual Acuity, Lenses, Intraocular, Refraction, Ocular.

How to Cite this Article: Haider MA, Sattar U. Visual Performance after Bilateral Implantation of Ray One EMV Intraocular Lens using Micro-Monovision Strategy. 2026;42(4):355-359. **Doi: 10.36351/pjo.v42i4.2271**

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Received: November 12, 2025

Revised: July 25, 2026

Accepted: September 20, 2026

INTRODUCTION

The number of individuals undergoing cataract extraction has increased due to improvements in cataract surgery techniques and longer life expectancies. The need for spectacle-free vision at all distances following cataract surgery is growing as modern lifestyles demand more visual independence. Numerous intraocular lens technologies, such as

multifocal and extended depth of focus (EDOF) IOLs, have been introduced to meet this demand.^{1,2}

Multifocal IOLs enhance postoperative vision by dividing light into multiple focal points, thereby reducing spectacle dependence.³ However, they may be associated with drawbacks such as photic disturbances (including halos and glare) and reduced contrast sensitivity. EDOF intraocular lenses offer a continuous range of vision with less photic issues, serving as a middle ground between monofocal and multifocal IOLs. Traditional EDOF IOLs may not provide the same near-visual acuity as multifocal IOLs, despite their advantages.^{4,5}

To optimize near vision while maintaining benefits of EDOF lenses, micro-monovision has been explored. In this approach, emmetropia is targeted for dominant

eye, while in non-dominant eye slight myopic shift is induced. This strategy, has shown the extended range for functional vision, preserve stereopsis, and reduced spectacle dependence.⁶

To enhance the depth of focus, EDOF IOLs use a variety of optical designs, such as diffractive, nondiffractive, bioanalogic, and small-aperture technologies.⁷ The nondiffractive EDOF IOLs, such as the RayOne EMV IOL, utilize X-wave technology to elongate the focal range without splitting light into multiple foci. This IOL is designed to offer good intermediate vision while minimizing visual disturbances. Despite multiple clinical studies confirming the safety and efficacy of this lens, limited data exist on its subjective and objective visual performance following bilateral implantation in the literature.⁸ Memon et al, compared the visual outcomes by using three types of monofocal intraocular lenses. According to their retrospective comparative study, all three types of monofocal IOL had similar visual outcomes.⁹

This study aimed to analyze the visual outcomes, defocus curve, and patient satisfaction after bilateral implantation of the Rayone EMV IOL using a micro-monovision therapy.

METHODS

This retrospective chart review was conducted at Al-Ehsan Welfare Eye Hospital. It included patients between the ages of 45-60 years who underwent cataract surgery (bilateral) with Rayone EMV IOL implantation from January 2024 to December 2024. Total, 20 individuals, were included. The institutional review board of El-Ahsan Hospital, Lahore approved the study (**Reference no: AEWS/MS/HR**). Enrolled patients had a preoperative BCVA of at least 6/12 and corneal astigmatism not exceeding 3D. Individuals were excluded if they had any other significant ocular pathology, intraoperative or postoperative complications and a history of other ocular surgery. Informed consent was taken from all selected participants. All surgeries, using standard phacoemulsification techniques, were performed by an experienced ophthalmologist. SRK-T formula was used to calculate the IOL power, targeting emmetropia in the dominant eye and a slight myopic shift of -0.50D to -0.75D in the other eye to achieve micro-monovision.

Postoperative assessment at three months included

binocular uncorrected distance visual acuity at 6m (UCDVA), intermediate visual acuity at 66cm (UCIVA) and near vision at 40cm (UCNVA). Functional vision was further evaluated by plotting a binocular defocus curve, measured in 0.50D increments from +1.00D to -4.00D. Subjective outcomes, including patient satisfaction, visual quality, and spectacle independence were assessed with a standardized patient questionnaire. SPSS software (version 22) was used for data analysis. Descriptive statistics were displayed as mean $\pm$ standard deviation for continuous variables and as percentages for categorical variables.

RESULTS

Average age of the patients was 53.9 ± 4.5 year (45-60 years), with 65% males and 35% females. After three months of surgery, most patients (70%) achieved excellent UCDVA on log Mar (0.00), with 90% attaining 0.10 or better (Table 1). Only 10% showed a reduced outcome (0.20). Similarly, 90% patients achieved UCIVA of 0.00 (log Mar), only a small percentage (10%) showed a slightly worse UCIVA values (0.18 or 0.20). In terms of near vision, 90% achieved UCNVA of 0.11 (log Mar), indicating good uncorrected near vision after surgery. Only 10% had slightly worse UCNVA values (0.12 or 0.14).

Table 1: Frequency of Uncorrected Distance (UCDVA), Intermediate (UCIVA) and Near Visual Acuity (UCNVA).

	LogMAR Visual Acuity	Frequency	Percent
Uncorrected Distance Visual Acuity	.00	14	70
	.10	4	20
	.20	2	10
	Total	20	100
Uncorrected Intermediate Visual Acuity	.00	18	90
	.18	1	5
	.20	1	5
	Total	20	100
Uncorrected Near Visual Acuity	.11	18	90.0
	.12	1	5.0
	.14	1	5.0
	Total	20	100.0

After three months of Rayone EMV IOL implantation, 75% patients showed spectacle independence, 15% required on-and-off glasses, and 10% needed glasses for near. Similarly, 85% showed spectacle independence, 10% required on-and-off glasses, and 5% needed glasses for intermediate, and

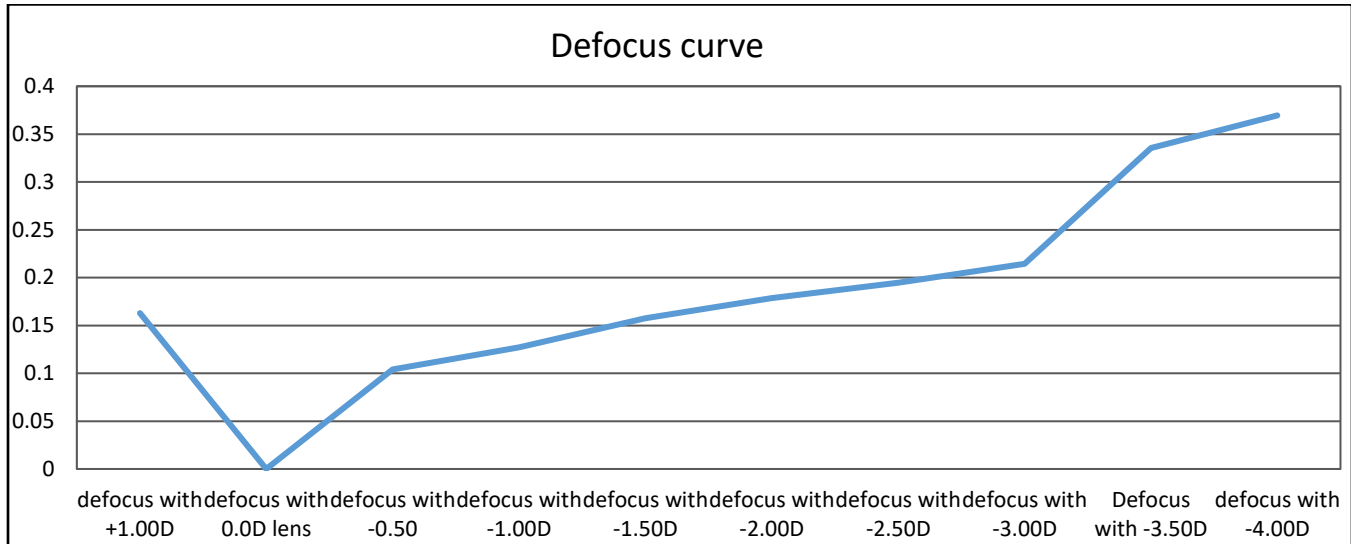


Figure 1: The x-axis represents the defocus level (D), ranging from +1.00D to -4.00D. The y-axis represents the average visual acuity.

70% showed spectacle independence, 10% required on-and-off glasses, and 20% needed glasses for near.

After binocular Rayone EMV IOL implantation, using micro-monovision strategy, we were able to draw a defocus curve (Fig. 1). The x-axis represents the defocus level (D), ranging from +1.00D to -4.00D. The y-axis represents the average visual acuity. This curve showed how visual acuity changes as defocus increases. There is a slight drop at 0.00D (distance vision), indicating a very slight reduction in visual acuity by defocusing (placing minus lens of gradually increasing power from -0.5D to -4.00D in front of 0.0 or 6/6 eye). The progressive improvement in visual acuity for both intermediate and near distances indicates that the RayOne EMV IOL implantation using micro-monovision strategy offers a seamless and extended depth of focus, making it advantageous for patients who require strong near and intermediate vision.

DISCUSSION

This study showed excellent visual results for near, intermediate, and distance vision after bilateral implantation of RayOne EMV intraocular lens (IOL) using a micro-monovision technique. Literature reviews indicate that EDOF IOLs, such as RayOne EMV, offer a constant field of vision with fewer photic disturbances compared to multifocal lenses, which often compromise contrast sensitivity and induce glare.¹⁰

Previous research has demonstrated that EDOF

IOL provides outstanding uncorrected vision for near, intermediate, and far distances. The literature also emphasizes the importance of patient-reported outcomes, with high satisfaction rates reported among patients receiving EDOF IOLs.^{11,12}

In our study, most patients attained 0.00, signifying exceptional distance vision without the need for correction. The uncorrected UCIVA results were particularly strong, with 90% of patients achieving 0.00 and UCNVA was favorable, with 90% of patients achieving 0.11, reflecting good near vision performance. The results of this study are also consistent with research on EDOF IOLs, which have shown superior intermediate vision when compared to conventional monofocal lenses while minimizing the glare and haloes (visual disturbances) commonly associated in multifocal IOLs.^{13,14} The RayOne IOL's X-Wave technology, which extends the focusing range without light splitting into multiple foci, likely contributes to this enhanced intermediate and near-vision performance.

Spectacle independence was another key outcome of this study. Among the 20 patients, 15 achieved complete spectacle independence, while a few required glasses occasionally for near tasks. The high prevalence of spectacle-free vision supports the effectiveness of the micro-monovision strategy, which involves targeting the emmetropia in the dominant eye and a slightly myopic shift for the non-dominant eye. This method improves near vision while maintaining depth perception and clarity of distance vision.^{15,16}

The defocus curve analysis revealed a smooth and

extended range of functional vision, with minimal drop in acuity across different defocus levels.^{17,18} The RayOne EMV IOL's effectiveness is further supported by the slight reduction in visual acuity at 0.00D (distance vision), which is followed by a gradual improvement in intermediate and near vision. These findings are in line with earlier research demonstrating that multifocal IOLs cause more photic disturbances than extended depth of focus (EDOF) IOLs, which offer a continuous range of vision.¹⁹

One of the primary concerns with advanced IOLs is the occurrence of glare, halos, and other photic disturbances.²⁰ In this study, most patients reported minimal glare sensitivity, and none experienced severe visual discomfort. Additionally, the patient satisfaction scale (ranging from 1 to 10) indicated high levels of comfort and contentment, particularly with intermediate and near vision.

This study has some limitations. The small sample size (n=20) and its retrospective design restrict the applicability of the findings. To validate these findings, future studies with bigger cohorts and longer follow-up would be beneficial. Additionally, incorporating objective measurements of contrast sensitivity and more comprehensive patient-reported quality-of-life evaluations can offer more thorough understanding of the long-term benefits of this IOL.

CONCLUSION

RayOne EMV IOL, implanted bilaterally with a micro monovision strategy, yields outstanding visual and clinical outcomes, especially for near, intermediate, and distance vision. Minimal photic disturbances, patient-reported satisfaction, and considerable spectacle free vision make this IOL a viable option for patients seeking high-quality vision after cataract surgery.

Funding: This study was not funded by any organization.

Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (AEWS/MS/HR)

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Authors Designation and Contribution

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Uzma Sattar; Optometrist: *Design, Literature Search, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

