

ORIGINAL ARTICLE

VISUAL OUTCOMES WITH INTRAOCULAR TRIFOCAL LENS
IMPLANT

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Background: Cataract surgery has become one of the most common surgeries in the world with one in every four surgeries performed being a cataract extraction and the numbers are expected to increase by 16 percent in the USA alone by 2024 as compared to the current statistics. The aim of the study is to analyze the visual outcomes of intraocular lens implants for various visual ranges.

Methods: This non-comparative interventional study was conducted at the Ophthalmology department of Al Ehsan Eye Hospital from Jan to Dec 2021. It included patients who underwent uneventful phacoemulsification with an intraocular lens implant and analysis of the visual outcomes for uncorrected distance (UDVA), uncorrected intermediate distance (UIVA), and uncorrected near distance (UNVA). **Results:** Independent sample t-test was applied to observe the mean values of recorded far vision on the 1st day, 1 week, and 1 month after the trifocal intraocular lens implantation. It showed a significant difference with a *p*-value of 0.00 on 1st day, 1 week, and 1 month after was 0.3 ± 0.1 , 0.17 ± 0.09 , and 0.14 ± 0.08 respectively. Mean improvement in near vision after 1 month was N6 with S.D 1.03 and in intermediate vision was $N8 \pm 1.4$ respectively.

Conclusion: Trifocal Intraocular lens implantation offers an improved vision for near, intermediate, and distant visual ranges without the need for correction.

Keywords: Trifocal Intraocular Lens; Phacoemulsification; Visual acuity

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INTRODUCTION

Cataract surgery has become one of the most common surgeries in the world with one in every four surgeries performed being a cataract extraction and the numbers are expected to increase by 16 percent in the USA alone by 2024 as compared to the current statistics.¹

The gold standard procedure that has now evolved to maturity is to treat compromised vision due to the development of the cataract with phacoemulsification and intraocular lens implantation (IOL). Monofocal IOLs are commonly used for replacement, it has only one focal point so the lens can display a clear image for either near or distant vision. Some of these patients experience effects such as glare and haloes post-operatively and spectacle dependence.²

In order to attain better visual outcomes over a range of distances without spectacle dependence for the patients, trifocal IOLs were developed and their introduction in cataract surgery is a step closer to achieving near-natural image quality. A trifocal IOL provides a clear image over a range of distances since it focuses images for near, intermediate, and distant distances at the same time. This has been made possible by technological advances in trifocal IOLs that have incorporated multiple focal points in ring-like graded

zones capable of focusing a sufficient amount of light through all three vision ranges.³

Incorporating technological advances these IOLs use diffracted light from intermediate and near focal points. This helps in conserving lighter for optimal optical effects resulting in trifocal lens to lose only 12% of the incident light as compared to bifocal IOLs 19%. This displayed a continuous and extraordinary acuity and improved intermediate vision.

The uncorrected improvement of all three vision ranges also helped reduce the side effects after IOL implantation and patient response grew positively and help achieve a spectacle-free vision for the visual ranges.⁴ This upgrade led to a better visual experience and contentment among patients to the extent that during clinical trials 99% of the patients opted for the same lens.

Patients are in continuous search of the best options available to them when it comes to health issues. Considering the fact that patients in need of cataract surgery are above 60 years of age, their acuity in most cases is compromised considering underlying factors they require optimal visual correction to live a dependence-free life. This study was conducted to document the visual performance of trifocal intraocular

lens for near, intermediate and distant visions in our hospital settings. It included 30 eyes of 15 patients who underwent phacoemulsification and cataract extraction with a trifocal PanOptix lens implantation followed by detailed documentation and analysis of the visual outcomes for uncorrected distance (UDVA), uncorrected intermediate distance (UIVA), and uncorrected near distance (UNVA).

MATERIAL AND METHOD

This non-comparative interventional study was performed at Al Ehsan Eye Hospital, Lahore a tertiary care eye hospital. The study was conducted during the period from Jan to Dec 2021.

Patients were selected from the outpatient department. Patients diagnosed with cataract as the primary cause of decrease vision were inducted in the study. Careful attention was given to their lifestyles and judging them to be ideally suited for a trifocal lens implant according to their everyday activities and needs in order to improve patient’s individual quality of life. All patients underwent a standard screening protocol and were counselled and informed about the surgical procedure and about the trifocal lens to be implanted before the surgery. Patients who agreed to be part of the study and agreed for trifocal implant underwent a standard ophthalmic examination. This included documentation of visual acuity, anterior and posterior segment examination. Patient’s inclusion criteria included age between twenty-five to eighty years, with no anterior or posterior segment pathologies and requiring cataract surgery for visual rehabilitation secondary to age related cataract. Patients with any history of trauma, media opacities, anterior segment or posterior segment pathologies such as uveitis, retinal

vascular diseases, glaucoma, degenerative or inherited diseases were excluded from the study.

The patients operated by a single cataract surgeon. All those diagnosed with cataracts and fulfilling the inclusion and exclusion criteria then underwent baseline blood tests, viral serology with ELISA and biometry with IOL Master for IOL power calculations. After undertaking relevant consent all patients were prepped, vitals recorded, eyes marked, pupils dilated using 2.5% Phenylephrine and 1% Mydraciyl eye drops. Standard phacoemulsification was performed on all patients and all eyes were implanted with Alcon PanOptix Trifocal lens. All surgeries performed were uneventful and all patients prescribed steroid and antibiotics eye drops for post operative use. The patients were instructed to remove the eye pads four hours after surgery and start the drops at two hourly intervals. All patients were examined on the next day in outpatient department by the operating surgeon. All collected data was entered and analyzed by using SPSS 22 software.

Normality assumption was checked by shapiro-wilk test which showed the abnormal distribution with sig. 0.00. Independent t-test was applied for data analysis where *p*-value of 0.05 was considered as significant.

RESULTS

An Independent sample t-test was applied to observe the mean values of recorded far vision at 1stday, 1 week and 1 month after the trifocal intraocular lens implantation. It showed the significance difference with *p* value 0.00 at 1st day, 1 week and 1 month after was 0.3±0.1, 0.17±0.09 and 0.14±0.08 respectively.

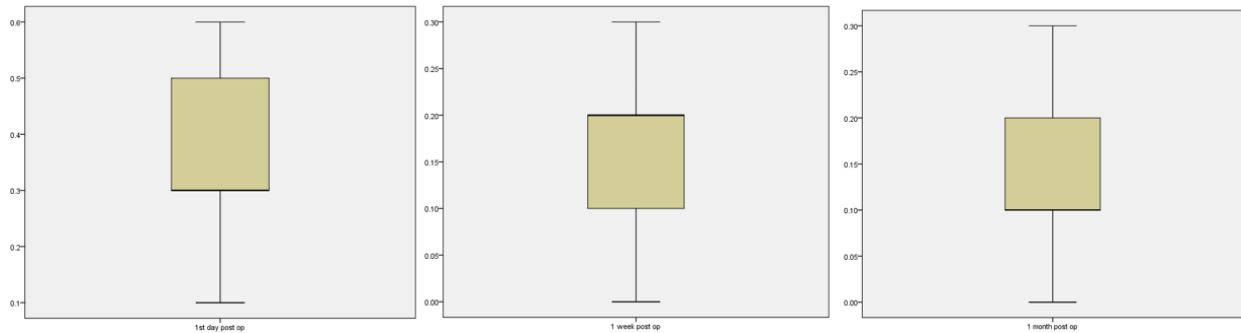


Figure-1: Comparison of Far vision after 1day, 1 week and 1 month of Trifocal Intraocular lens Implantation

Table-1: Evaluation of normal distribution of data

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
1st day post op	.335	30	.000	.830	30	.000
1 week post op	.223	30	.001	.874	30	.002
1 month post op	.267	30	.000	.870	30	.002

a. Lilliefors Significance Correction

Mean improvement in near vision after 1 month was N6 with S.D 1.03 and in intermediate vision was N8±1.4 respectively.

Table-2: Descriptive statistics of near, intermediate and far vision

	N	Minimum	Maximum	Mean	Std. Deviation
Near vision	15	N6	N8	6.93	1.033
Intermediate vision	15	N6	N12	8.53	1.407
Valid N (listwise)	15				

Table-3: Independent sample comparison of far vision at different durations

	N	Mean	Std. Deviation	Std. Error Mean	Significance (2-tailed)
1st day post op	30	.3533	.12243	.02235	0.000
1 week post op	30	.1667	.09589	.01751	0.000
1 month post op	30	.1367	.08503	.01552	0.000

DISCUSSION

Incorporating three distinct focal points for far, intermediate and near distances, trifocal IOLs are a huge improvement in IOL design as compared to earlier lenses.⁵

This study focused on recording the improvement in near, intermediate, and distant vision after cataract surgery following the implantation of a trifocal IOL. The mean value recorded for far vision at 1st day, 1 week, and 1 month showed a significant difference, *p*-values being 0.3, 0.17, and 0.14, respectively.

Considering the *p*-value, the results are not statistically significant. Monofocal IOL proved to be a better option for uncorrected distant visual acuity (UDVA) compared to an apodised multifocal IOL, during research on 4 different IOL models, in spite of the fact that the difference in their results was low.

In the case of near visual acuity, the mean improvement for 1 month was N6, 0.3 LogMar at 40 cm, and excellent results for intermediate vision which was N8, 0.0 LogMar at 100 cm.

The post operative visual acuity results achieved in our study resulted in level of satisfaction of our patients. Our results compared to other results as achieved by other studies. In one of the FDA studies, multifocal IOL reduced spectacle dependence to 15.2%. Similarly, Wilkins *et al* reduced the dependence to 28% in their RCT.⁶

Trifocal IOLs are designed differently from monofocal IOLs on the basis of their better performance when it comes to near and intermediate vision. We used AcrySof PanOptix trifocal IOL in our study which obtained a mean value of 6.93 for uncorrected near visual acuity (UNVA) 1-month post operatively.

However, studies have shown that near vision shows relatively better outcomes when the eye is implanted with a diffractive multifocal IOL as compared to a trifocal lens since this type of lens is not entirely dependent on the pupil for visual acuity. Thus, making activities like reading even small print sizes easy for patients, without spectacle. This lens makes use of 88% of light energy hence being more

efficient and independent of the size of pupil in various light intensities.^{7,8}

PanOptix trifocal IOL shines in the intermediate visual range since it is structurally designed to provide vision at an intermediate distance of 60cm or arms-length in simple terms.^{9,10} This differentiates it from other trifocal IOLs which are designed for an optimal range of 80 cm. This makes it more comfortable for the eye to perform daily routine functions in the modern lifestyles like working on computers and using mobile phones as these activities are performed at intermediate distances and are carried out by majority during their day-to-day activities.^{11,12} Our study findings showed a mean value of 8.53, 1 month postoperatively for intermediate vision. Patients receiving PanOptix IOL, in general, have reported contentment in overall quality of life especially concerning intermediate vision because it is the most impactful range of vision for working for the majority of patients in recent years. The advantage of trifocal automation is its ability to focus on intermediate vision without compromising distant and near visual acuity.¹³ One of the studies showed outstanding visual acuity of LogMAR <0.1 between +0.50 and -2.00 D on the monocular defocus curves for the PanOptix trifocal IOL, also proven in numerous other studies.^{14,15}

Though our study did not focus on unwanted optical images however they are a leading cause of patient dissatisfaction after uncomplicated cataract surgery. In one of the trials, glare was one of the leading causes of dissatisfaction after a multifocal implant.¹⁶ Other major dysphotopias was Contrast sensitivity. Neuroadaptation is one factor that needs to be taken into account as the brain needs a minimum of 3 months to as long as a year to adjust to the visuals created by multifocal IOLs.

However, in contrast to other multifocal lenses (At LISA tri 839MP and Fine vision trifocal IOL) AcrySof PanOptix IOL was found to have improved standard of vision with fewer cases reporting issues relating to dysphotopsia with the photic phenomena diminishing with time.¹⁷ This has been documented in previous meta-analysis results that concluded in favour of trifocal IOLs as the issue

of photic phenomena and contrast sensitivity depreciate over time.^{18,19}

The limitation of our study is its scope with fewer participants which was primarily due to the constraints faced in our clinical practice because of the cost of the surgical procedure.

CONCLUSION

Trifocal Intraocular lens implantation offers an improved vision for near, intermediate, and distant visual ranges without the need for correction.

AUTHORS CONTRIBUTION

All the authors contributed equally according to their assigned roles in the project.

REFERENCES

1. Yee KM, Tan S, Oberstein SY, Filas B, Nguyen JH, Nguyen-Cuu J, *et al.* Incidence of cataract surgery after vitrectomy for vitreous opacities. *Ophthalmol Retina* 2017;1(2):154–7.
2. Cochener B, Vryghem J, Rozot P, Lesieur G, Chevalier JP, Henry JM, *et al.* Clinical outcomes with a trifocal intraocular lens: a multicenter study. *J Refract Surg* 2014;30(11):762–8.
3. Moshirfar M, Ellis J, Beesley D, McCabe SE, Lewis A, West WB, *et al.* Comparison of the visual outcomes of an extended depth-of-focus lens and a trifocal lens. *Clin Ophthalmol* 2021;15:3051–63.
4. Kuhn-Wilken O. Meet the New Trifocal IOL [Internet]. [cited 2022 July]. Available from: <https://www.reviewofoptometry.com/article/meet-the-new-trifocal-iol>
5. Sudhir RR, Dey A, Bhattacharyya S, Bahulayan A. AcrySof IQ PanOptix intraocular lens versus extended depth of focus intraocular lens and trifocal intraocular lens: a clinical overview. *Asia Pac J Ophthalmol (Phila)* 2019;(4):335–49.
6. Palmer AM, Faiña PG, Albelda AE, Saad DN, Céspedes MC. Visual function with bilateral implantation of monofocal and multifocal intraocular lenses: a prospective, randomized, controlled clinical trial. *J Refract Surg* 2008;24(3):257–64.
7. Akman A, Asena L, Ozturk C, Güngör SG. Evaluation of quality of life after implantation of a new trifocal intraocular lens. *J Cataract Refract Surg* 2019;45(2):130–4.
8. Cochener B, Vryghem J, Rozot P, Lesieur G, Heireman S, Blanckaert JA, *et al.* Visual and refractive outcomes after

- implantation of a fully diffractive trifocal lens. *Clin Ophthalmol* 2012;6:1421–7.
9. Jonker SM, Bauer NJ, Makhotkina NY, Berendschot TT, van den Biggelaar FJ, Nuijts RM. Comparison of a trifocal intraocular lens with a +3.0 D bifocal IOL: results of a prospective randomized clinical trial. *J Cataract Refract Surg* 2015;41(8):1631–40.
10. Gundersen KG, Potvin R. Trifocal intraocular lenses: a comparison of the visual performance and quality of vision provided by two different lens designs. *Clin Ophthalmol* 2017;11:1081–7.
11. Lee S, Choi M, Xu Z, Zhao Z, Alexander E, Liu Y. Optical bench performance of a novel trifocal intraocular lens compared with a multifocal intraocular lens. *Clin Ophthalmol* 2016;10:1031–8.
12. Asena BS. Visual and refractive outcomes, spectacle independence, and visual disturbances after cataract or refractive lens exchange surgery: comparison of 2 trifocal intraocular lenses. *J Cataract Refract Surg* 2019;45(11):1539–46.
13. Plaza-Puche AB, Alió JL. Analysis of defocus curves of different modern multifocal intraocular lenses. *Eur J Ophthalmol* 2016;26(5):412–7.
14. Gatinel D, Pagnouille C, Houbrechts Y, Gobin L. Design and qualification of a diffractive trifocal optical profile for intraocular lenses. *J Cataract Refract Surg* 2011;37(11):2060–7.
15. Alió JL, Grabner G, Plaza-Puche AB, Rasp M, Pinero DP, Seyeddain O, *et al.* Postoperative bilateral reading performance with 4 intraocular lens models: six-month results. *J Cataract Refract Surg* 2011;37(5):842–52.
16. Kohnen T, Herzog M, Hemkepler E, Schönbrunn S, De Lorenzo N, Petermann K, *et al.* Visual performance of a quadrifocal (trifocal) intraocular lens following removal of the crystalline lens. *Am J Ophthalmol* 2017;184:52–62.
17. Kretz FT, Breyer D, Diakonis VF, Klabe K, Henke F, Auffarth GU, *et al.* Clinical outcomes after binocular implantation of a new trifocal diffractive intraocular lens. *J Ophthalmol* 2015;2015:962891.
18. Martinez-de-la-Casa JM, Carballo-Alvarez J, Garcia-Bella J, Vazquez-Molini JM, Morales L, Sanz-Fernandez JC, *et al.* Photopic and mesopic performance of 2 different trifocal diffractive intraocular lenses. *Eur J Ophthalmol* 2017;27(1):26–30.
19. Yoon CH, Shin IS, Kim MK. Trifocal versus bifocal diffractive intraocular lens implantation after cataract surgery or refractive lens exchange: a meta-analysis. *J Korean Med Sci* 2018;33(44):e275.

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