

Comparison of Visual and Refractive Outcomes Between Different Intraocular Lens Types Following Phacoemulsification

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ARTICLE INFO

Received: 23 September 2026
Accepted: 29 September 2026
Published Online: 3 October 2026

DOI: 10.5281/zenodo.23122431

Volume: 10, Number: 3, Page: 920-925

e-ISSN: 2789-5912
ISSN: 2617-0817

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ABSTRACT

Background: Cataract is a common cause of visual impairment, and phacoemulsification with intraocular lens (IOL) implantation is widely used to restore vision. However, visual and refractive outcomes may vary depending on the type of IOL used. **Objective:** This study compared the visual and refractive outcomes of monofocal, multifocal, extended depth-of-focus (EDOF), and toric IOLs following phacoemulsification. **Methods & Materials:** This prospective comparative study was conducted in the Ophthalmology Department of Satkhira Medical College from April 2025 to March 2026. It included 100 patients undergoing uncomplicated phacoemulsification: 40 received monofocal IOLs, while 20 each received multifocal, EDOF, or toric IOLs. Visual acuity and refraction were assessed preoperatively and during 6 months of follow-up. Outcomes included UCVA, BCVA, spherical equivalent, residual astigmatism, target-refraction achievement, and postoperative complications. **Results:** Participants had a mean age of 61.8 ± 8.7 years, and 58.0% were male. Visual acuity improved significantly in all groups at 6 months ($p < 0.001$). Mean 6-month UCVA was 0.18 ± 0.12 , 0.13 ± 0.09 , 0.12 ± 0.08 , and 0.15 ± 0.10 logMAR in the monofocal, multifocal, EDOF, and toric groups, respectively, with no significant between-group difference ($p = 0.071$). Residual astigmatism was lowest in the toric group (-0.31 ± 0.27 D; $p = 0.006$). Spherical equivalent within ± 0.50 D of target was achieved in 67.5%, 85.0%, 90.0%, and 85.0% of the respective groups ($p = 0.047$). Overall, 82.0% had no postoperative complications. **Conclusion:** All four IOL types significantly improved vision after phacoemulsification. Toric IOLs reduced residual astigmatism,

while EDOF IOLs showed favorable visual and refractive outcomes. Selection should reflect ocular characteristics, refractive status, and individual visual needs.

Keywords: Cataract; Phacoemulsification; Intraocular Lens; Refractive outcome; Visual Acuity.

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INTRODUCTION

Cataract, characterised by progressive opacification of the crystalline lens, remains the leading cause of reversible blindness worldwide. Current global estimates indicate that cataract accounts for approximately 45% of blindness, with more than 94 million individuals experiencing cataract-related visual impairment.^[1,2] In Bangladesh, cataract continues to represent a major cause of avoidable visual disability, and the demand for cataract surgery is expected to increase with population ageing and the growing prevalence of age-related ocular disorders.^[1,3] Phacoemulsification with intraocular lens (IOL) implantation has become the standard surgical approach for cataract management because of its minimally invasive nature, rapid visual rehabilitation, and predictable refractive outcomes.^[4] Nevertheless, appropriate IOL selection remains an important determinant of postoperative visual performance, refractive status, and patient satisfaction.^[5] The contemporary IOL spectrum includes monofocal, multifocal, extended depth-of-focus (EDOF), and toric lenses, each incorporating distinct optical characteristics and providing specific

visual benefits.^[5] Monofocal IOLs generally offer satisfactory distance visual acuity but frequently necessitate spectacle correction for near vision.^[6] In contrast, multifocal and EDOF IOLs are designed to provide an extended range of functional vision and thereby reduce postoperative spectacle dependence.^[7,8] Comparative studies have demonstrated favorable distance visual outcomes with monofocal, multifocal, and EDOF IOLs, although their intermediate and near visual performance differs according to lens design.^[9] Similarly, toric IOLs have demonstrated favorable refractive and patient-reported outcomes in the correction of pre-existing corneal astigmatism during phacoemulsification, with several studies reporting advantages over limbal relaxing incisions.^[10] Despite these technological advances, the selection of an appropriate IOL remains individualized and depends on preoperative ocular characteristics, visual requirements, lifestyle expectations, and economic considerations.^[11] In Bangladesh, although several studies have evaluated visual and refractive outcomes following cataract surgery, comparative evidence concerning different IOL categories following

phacoemulsification remains limited.^[12] A previous study conducted in a Bangladeshi population comparing monofocal and monofocal-plus IOLs reported improved visual performance and greater patient satisfaction among recipients of monofocal-plus lenses.^[13] However, comparative data encompassing a wider range of contemporary IOL designs remain insufficient. This evidence gap is particularly relevant given the increasing availability of premium IOL technologies and the growing expectations of patients regarding postoperative visual quality and spectacle independence. Therefore, the present study aims to comparatively evaluate the visual and refractive outcomes associated with different IOL types following phacoemulsification. Assessment of postoperative visual acuity, refractive outcomes, and patient satisfaction may provide clinically relevant evidence to facilitate individualized IOL selection. The findings may also contribute to the development of evidence-based cataract surgical practice and improve the optimization of postoperative visual outcomes in the Bangladeshi population.

OBJECTIVE

General Objective

To compare visual and refractive outcomes among different IOL types following phacoemulsification in 100 patients at Satkhira Medical College from April 2025 to March 2026.

Specific Objectives

- 1. To compare postoperative UCVA and BCVA among different IOL groups.
- 2. To compare spherical equivalent, residual astigmatism, and target refraction between IOL groups.
- 3. To determine the proportion of patients achieving UCVA $\geq 6/12$ and spherical equivalent within ± 0.50 D.

METHODS & MATERIALS

This prospective comparative study will be conducted in the Department of Ophthalmology, Satkhira Medical College, Satkhira, over a one-year period from 1 April 2025 to 31 March 2026. A total of 100 patients undergoing phacoemulsification with intraocular lens (IOL) implantation will be included, with one eye selected from each patient. Participants will be recruited purposively from patients attending the outpatient department and those admitted for cataract surgery. Ethical approval will be obtained from the Institutional Review Board of Satkhira Medical College. Written informed consent will be obtained from all participants, and confidentiality of patient

information will be strictly maintained throughout the study. The study will be conducted in accordance with the principles of the Declaration of Helsinki. Patients aged 40 years or older with age-related cataract who are suitable for uncomplicated phacoemulsification will be included. Patients with traumatic or complicated cataract, corneal opacity, glaucoma, uveitis, retinal or optic nerve disease, previous intraocular surgery, intraoperative complications, or other ocular or systemic conditions likely to affect visual outcomes or follow-up will be excluded. Written informed consent will be obtained from all participants. Before surgery, each patient will undergo a detailed clinical assessment, including history taking, uncorrected and best-corrected distance visual acuity (UDVA and BCVA), slit-lamp examination, intraocular pressure measurement, and fundus examination. Ocular biometry, including axial length and keratometry, will be performed for appropriate IOL power calculation. All patients will undergo standard phacoemulsification under topical or peribulbar anaesthesia. The procedure will include a clear corneal incision, continuous curvilinear capsulorhexis, hydrodissection, phacoemulsification, and implantation of the selected IOL within the capsular bag. Patients will be categorised according to the type of IOL implanted, including monofocal, multifocal, extended depth-of-focus (EDOF), or toric IOLs, depending on clinical indications and

patient requirements. Postoperative assessments will be performed at 1 day, 1 week, 1 month, 3 months, and 6 months. At each relevant visit, UDVA, BCVA, manifest refraction, spherical equivalent, residual astigmatism, and achievement of the intended target refraction will be recorded using a structured data collection form.

The collected data will be entered and analysed using SPSS software. Continuous variables will be presented as mean $\pm$ standard deviation and compared using appropriate statistical tests, such as the independent t-test or one-way ANOVA. Categorical variables will be presented as frequencies and percentages and analysed using the chi-square test. A p-value of <0.05 will be considered statistically significant.

RESULTS

A total of 100 patients undergoing uncomplicated phacoemulsification with IOL implantation were included in the study. The patients were categorised into four groups according to the type of IOL implanted: monofocal (n=40), multifocal (n=20), EDOF (n=20), and toric (n=20). The results were analysed in terms of demographic characteristics, postoperative visual acuity, refractive outcomes, achievement of target refraction, and postoperative complications.

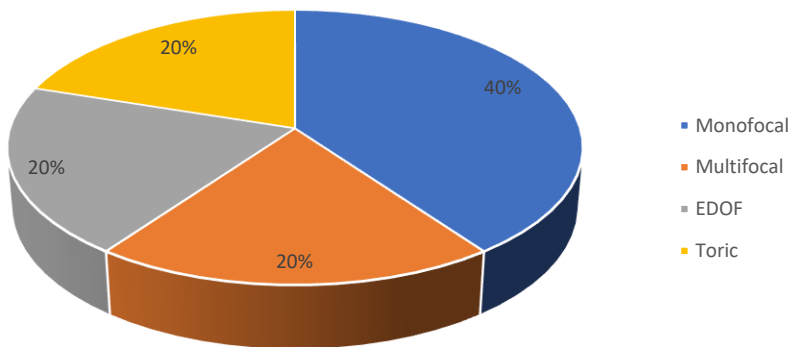


Figure 1 Distribution of patients according to IOL type (n=100).

Figure 1 indicates that among the subjects, 40 individuals (40.0%) received monofocal IOLs, whereas 20 individuals (20.0%) each were administered multifocal, EDOF, and toric IOLs.

Table 1 shows the mean age was 61.8 ± 8.7 years, with 40.0% in the 61–70-year group and 31.0% in 51–60. The mean age was highest in the toric group (63.0 ± 9.1) and lowest in the multifocal group (60.1 ± 7.8).

Males made up 58.0%, females 42.0%, with similar age and sex distribution across groups.

Table IDemographic characteristics of the study participants ($n=100$).

Characteristics	Monofocal (n=40)	Multifocal (n=20)	EDOF (n=20)	Toric (n=20)	Total
Age (years)	40–50	4 (10.0)	3 (15.0)	2 (10.0)	12 (12.0)
	51–60	12 (30.0)	7 (35.0)	5 (25.0)	31 (31.0)
	61–70	17 (42.5)	7 (35.0)	9 (45.0)	40 (40.0)
	>70	7 (17.5)	3 (15.0)	4 (20.0)	17 (17.0)
	mean $\pm$ SD	62.4 $\pm$ 8.9	60.1 $\pm$ 7.8	61.0 $\pm$ 8.2	63.0 $\pm$ 9.1
Gender, n (%)	Male	23 (57.5)	11 (55.0)	12 (60.0)	58 (58.0)
	Female	17 (42.5)	9 (45.0)	8 (40.0)	42 (42.0)

Table II indicates that preoperatively, mean UCVA across all groups was poor, from 0.84 $\pm$ 0.29 logMAR in the multifocal to 0.91 $\pm$ 0.34 in the toric. Post-phacoemulsification, UCVA improved in all IOL groups, reaching at 1 month 0.25 $\pm$ 0.14, 0.20 $\pm$ 0.12, 0.19 $\pm$ 0.11, and

0.23 $\pm$ 0.13 logMAR for monofocal, multifocal, EDOF, and toric, respectively. Further gains were seen at 3 and 6 months, with UCVA at 6 months being 0.18 $\pm$ 0.12, 0.13 $\pm$ 0.09, 0.12 $\pm$ 0.08, and 0.15 $\pm$ 0.10 logMAR. The EDOF group had the lowest UCVA, but differences among groups were

not statistically significant ($p=0.071$). BCVA at 6 months was similar, ranging from 0.06 $\pm$ 0.05 to 0.08 $\pm$ 0.07 logMAR ($p=0.382$). All groups showed significant visual acuity improvement from baseline ($p<0.001$).

Table IIPreoperative and postoperative visual acuity according to IOL type ($n=100$).

IOL type	Preoperative UCVA (logMAR)	1 month UCVA	3 months UCVA	6 months UCVA	6-month BCVA (logMAR)
Monofocal	0.86 $\pm$ 0.32	0.25 $\pm$ 0.14	0.21 $\pm$ 0.13	0.18 $\pm$ 0.12	0.08 $\pm$ 0.07
Multifocal	0.84 $\pm$ 0.29	0.20 $\pm$ 0.12	0.16 $\pm$ 0.10	0.13 $\pm$ 0.09	0.07 $\pm$ 0.06
EDOF	0.88 $\pm$ 0.31	0.19 $\pm$ 0.11	0.15 $\pm$ 0.09	0.12 $\pm$ 0.08	0.06 $\pm$ 0.05
Toric	0.91 $\pm$ 0.34	0.23 $\pm$ 0.13	0.18 $\pm$ 0.11	0.15 $\pm$ 0.10	0.07 $\pm$ 0.06
p-value*	>0.05	0.184	0.096	0.071	0.382

*One-way ANOVA. Within-group improvement from baseline was statistically significant in all groups ($p<0.001$).

Table III indicates that at 6 months, the mean postoperative spherical equivalent was close to the target in all four groups. The mean spherical equivalent was -0.42 ± 0.48 D in the monofocal, -0.24 ± 0.35 D in the multifocal, -0.18 ± 0.31 D in the EDOF, and -0.20 ± 0.34 D in the toric group. The

difference among groups was not significant ($p=0.083$). Residual astigmatism was lowest in the toric group at -0.31 ± 0.27 D, compared to -0.71 ± 0.42 D in the monofocal, -0.58 ± 0.36 D in the multifocal, and -0.54 ± 0.34 D in the EDOF group—this was significant ($p=0.006$). Regarding target refraction, 67.5% of

monofocal patients achieved within ± 0.50 D, versus 85.0% in multifocal, 90.0% in EDOF, and 85.0% in toric groups, with significance ($p=0.047$). For ± 1.00 D, the proportions were 92.5%, 100.0%, 100.0%, and 100.0%, respectively ($p=0.161$).

Table IIIPostoperative refractive outcomes at 6 months ($n=100$).

Refractive outcome	Monofocal (n=40)	Multifocal (n=20)	EDOF (n=20)	Toric (n=20)	p-value
Spherical equivalent (D)	-0.42 ± 0.48	-0.24 ± 0.35	-0.18 ± 0.31	-0.20 ± 0.34	0.083
Residual astigmatism (D)	-0.71 ± 0.42	-0.58 ± 0.36	-0.54 ± 0.34	-0.31 ± 0.27	0.006
Within ± 0.50 D of target, n (%)	27 (67.5)	17 (85.0)	18 (90.0)	17 (85.0)	0.047
Within ± 1.00 D of target, n (%)	37 (92.5)	20 (100.0)	20 (100.0)	20 (100.0)	0.161

Table IV shows that at 6 months, UCVA of $\geq 6/12$ was achieved by 72.5% of patients in the monofocal group, 85.0% in the multifocal group, 90.0% in the EDOF group, and 80.0% in the toric group. Although the EDOF group had the highest

proportion, the difference was not significant ($p=0.268$). BCVA of $\geq 6/12$ was achieved by 95.0% in monofocal, 100.0% in multifocal and EDOF, and 95.0% in toric ($p=0.566$). The proportion with a spherical equivalent within ± 0.50 D was higher in

the multifocal, EDOF, and toric groups (85.0%, 90.0%, 85.0%) compared to monofocal (67.5%) ($p=0.047$). Target refraction was achieved in 72.5% monofocal, 90.0% multifocal and EDOF, and 85.0% toric ($p=0.184$).

Table IVProportion of patients achieving favourable visual outcomes at 6 months ($n=100$).

Outcome	Monofocal (n=40)	Multifocal (n=20)	EDOF (n=20)	Toric (n=20)	p-value
UCVA $\geq 6/12$, n (%)	29 (72.5)	17 (85.0)	18 (90.0)	16 (80.0)	0.268
BCVA $\geq 6/12$, n (%)	38 (95.0)	20 (100.0)	20 (100.0)	19 (95.0)	0.566
Spherical equivalent within ± 0.50 D, n (%)	27 (67.5)	17 (85.0)	18 (90.0)	17 (85.0)	0.047
Target refraction achieved, n (%)	29 (72.5)	18 (90.0)	18 (90.0)	17 (85.0)	0.184

Table V indicates that the mean enhancement in uncorrected distance visual acuity (UCVA) from baseline to six months

was 0.68 logMAR in the monofocal group, 0.71 logMAR in the multifocal group, and 0.76 logMAR in both the EDOF and toric

groups. The improvements observed were statistically significant across all groups ($p<0.001$).

Table V
Change in visual acuity from baseline to 6 months (*n*=100).

IOL type	Preoperative UCVA (logMAR)	6-month UCVA (logMAR)	Mean improvement	p-value
Monofocal	0.86±0.32	0.18±0.12	0.68	<0.001
Multifocal	0.84±0.29	0.13±0.09	0.71	<0.001
EDOF	0.88±0.31	0.12±0.08	0.76	<0.001
Toric	0.91±0.34	0.15±0.10	0.76	<0.001

Table VI shows postoperative complications were rare, with 82.0% of patients experiencing none. Mild inflammation was most common at 6.0%, followed by transient intraocular pressure elevation and posterior capsular opacification at 5.0% each. Cystoid macular edema occurred in 2.0%. The no-complication rate was 80.0% in monofocal and toric groups and 85.0% in multifocal and EDOF groups.

Table VI
Postoperative complications during follow-up (*n*=100).

Complication	Monofocal n (%)	Multifocal n (%)	EDOF n (%)	Toric n (%)	Total n (%)
Mild postoperative inflammation	3 (7.5)	1 (5.0)	1 (5.0)	1 (5.0)	6 (6.0)
Transient raised IOP	2 (5.0)	1 (5.0)	1 (5.0)	1 (5.0)	5 (5.0)
Posterior capsular opacification	2 (5.0)	1 (5.0)	1 (5.0)	1 (5.0)	5 (5.0)
Cystoid macular edema	1 (2.5)	0 (0.0)	0 (0.0)	1 (5.0)	2 (2.0)
No complication	32 (80.0)	17 (85.0)	17 (85.0)	16 (80.0)	82 (82.0)

DISCUSSION

This study assessed visual and refractive outcomes of four intraocular lens (IOL) types: monofocal, multifocal, extended depth-of-focus (EDOF), and toric in study patients undergoing phacoemulsification at Satkhira Medical College. At 6 months, all groups showed significantly improved visual acuity. EDOF lenses achieved the best mean uncorrected acuity (0.12±0.08 logMAR), although between-group differences were not significant. Significant differences occurred in residual astigmatism (*p*=0.006) and the percentage within ±0.50 D of target refraction (*p*=0.047). Toric lenses produced the lowest residual astigmatism (−0.31±0.27 D), while EDOF lenses achieved the highest target-refraction rate (90.0%). Complications were uncommon, with 82.0% experiencing none. Visual acuity improved significantly in all groups, with mean UCVA increasing by 0.68–0.76 logMAR (*p*<0.001), confirming substantial recovery after phacoemulsification with IOL implantation regardless of lens type. Previous studies similarly report good postoperative distance vision with modern IOLs: one randomised trial found no significant binocular UDVA or CDVA difference between non-diffractive EDOF and monofocal IOLs, while another reported comparable, excellent 6-month distance vision with EDOF, enhanced monofocal, and standard monofocal IOLs.^[7,14] In this study, the EDOF group had the best numerical UCVA at all postoperative assessments, improving from 0.19±0.11 logMAR at 1 month to 0.12±0.08 at 6 months. However, the 6-month difference was not statistically significant (*p*=0.071), so these results do not demonstrate superior distance vision. Instead, they indicate that EDOF IOLs provided distance outcomes

comparable to the other lenses. Previous research likewise found that EDOF lenses preserve good distance vision while improving intermediate and near vision. A meta-analysis of monofocal, enhanced monofocal, and EDOF IOLs reported similar distance acuity across groups, with better intermediate and near performance for EDOF lenses.^[15] Thus, the primary benefit of EDOF technology may be extending functional vision rather than improving distance acuity alone. Refractive outcomes differed more noticeably among IOL groups. Mean postoperative spherical equivalent was closest to plano with EDOF (−0.18±0.31 D), followed by toric (−0.20±0.34 D), multifocal (−0.24±0.35 D), and monofocal IOLs (−0.42±0.48 D); however, the difference was not significant (*p*=0.083). These findings align with Boz and Atum, who reported similar postoperative spherical equivalent and cylinder values across EDOF, enhanced monofocal, and standard monofocal groups. Most eyes were within ±0.50 D of emmetropia with a −0.25 D myopic target.^[14] Another study by Tañá-Sanz et al. found a mean postoperative spherical equivalent of −0.31 ± 0.30 D with a bi-aspheric non-diffractive EDOF IOL, consistent with the present group’s near-plano results.^[16] The proportion within ±0.50 D of the target differed significantly: 67.5% for monofocal, 85.0% for multifocal, 90.0% for EDOF, and 85.0% for toric IOLs (*p*=0.047). Hu et al. similarly found that toric IOLs achieved a significantly closer spherical equivalent to target (−0.17 ± 0.39 D) than limbal relaxing incisions, supporting their refractive predictability.^[10] Agarwal et al. reported a mean postoperative spherical equivalent of −0.17 ± 0.40 D with monofocal IOLs targeted for slight myopia to support intermediate

vision, rather than emmetropia.^[17] EDOF achieved the highest rate within the desired range, consistent with Boz and Atum’s findings. However, nonrandomized, clinically determined IOL selection may have introduced patient-related confounding, while the retrospective design created potential selection bias and confounding by indication.^[14] Residual astigmatism differed most clearly among the four groups. Toric IOLs produced the lowest mean residual astigmatism (−0.31±0.27 D), versus −0.71±0.42 D for monofocal, −0.58±0.36 D for multifocal, and −0.54±0.34 D for EDOF IOLs (*p*=0.006). This finding aligns with the primary function of toric IOLs: correcting pre-existing corneal astigmatism. A prospective comparison with limbal relaxing incisions found lower residual cylinder (0.67±0.28 D vs. 0.94±0.30 D, *p*<0.001) and better UDVA (0.15±0.03 vs. 0.20±0.03 logMAR, *p*<0.001) in the toric group.^[10] Other studies likewise report more effective astigmatism correction with toric IOLs than with non-toric approaches.^[18] Priyamvada et al. found greater reduction in corneal astigmatism (0.15±0.12 D vs. 0.63±0.37 D, *p*<0.001) and lower residual cylinder (0.05±0.15 D vs. 0.60±0.38 D, *p*=0.007) with toric IOLs than with opposite clear corneal incisions.^[18] These findings support toric IOL use when postoperative astigmatism control is important. The proportion achieving UCVA of 6/12 or better was highest with EDOF IOLs (90.0%), followed by multifocal (85.0%), toric (80.0%), and monofocal IOLs (72.5%), although the difference was not significant (*p*=0.268). This agrees with Wang et al., who found superior uncorrected near acuity with EDOF and multifocal IOLs versus monofocal IOLs

($P < 0.001$), with EDOF providing the best overall uncorrected acuity.^[8] Srinivasan et al.'s meta-analysis likewise found comparable distance acuity among monofocal, enhanced monofocal, and EDOF lenses (all $p > 0.05$), indicating no clear distance-vision advantage.^[19] BCVA of 6/12 or better was achieved by 95.0% of monofocal and toric patients and 100.0% of multifocal and EDOF patients ($p = 0.566$), demonstrating good corrected distance vision across groups. Boz and Atum similarly reported excellent, comparable six-month distance vision with EDOF, enhanced monofocal, and standard monofocal IOLs; all patients achieved binocular UDVA of 0.1 logMAR or better.^[14] These findings reflect modern IOLs' ability to provide excellent best-corrected distance outcomes regardless of optical design.^[20]

The favorable UCVA observed with multifocal and EDOF IOLs is consistent with their design, which aims to expand useful vision and reduce spectacle dependence. However, this study did not assess near or intermediate acuity, spectacle dependence, contrast sensitivity, glare, or halos. Thus, it cannot determine whether these lenses offered advantages in these areas. Although previous studies reported improved intermediate and near vision with EDOF and multifocal lenses, these outcomes require specific assessment and cannot be inferred from distance acuity alone.^[8,14,19]

The toric group showed a different outcome: its main benefit was reduced residual astigmatism rather than better distance visual acuity. Mean UCVA and BCVA did not differ significantly from the other groups, but residual cylinder was significantly lower. This is clinically relevant because postoperative astigmatism can impair uncorrected visual quality even when the spherical equivalent is near target. These findings support previous evidence that toric IOLs effectively correct corneal astigmatism during cataract surgery.^[10,18]

The postoperative safety profile was favorable, with 82.0% of patients experiencing no complications. Mild inflammation was most common (6.0%), followed by transient IOP elevation (5.0%), posterior capsular opacification (5.0%), and cystoid macular edema (2.0%). These findings align with published data: a prospective series of 1,500 patients reported early inflammation in 8.4%, acute IOP elevation in 4.7%, and CME in 3.2%. Zhu et al. reported a 10% transient day-1 IOP spike, and an IRIS Registry analysis found capsulotomy rates of 4.1% for monofocal and 21.2% for diffractive multifocal/EDOF eyes.^[21-23] Complication-free rates were similar across groups (80.0% monofocal and toric; 85.0% multifocal and EDOF; $p = \text{NS}$), consistent

with Boz and Atum.^[14] Distance visual acuity also did not differ significantly, although EDOF had the best numerical UCVA, consistent with Srinivasan et al.'s meta-analysis.^[19] Toric IOLs produced the least residual astigmatism, consistent with Hu et al. (0.67 ± 0.28 D vs. 0.94 ± 0.30 D, $p < 0.001$), whereas EDOF IOLs achieved the highest proportion within ± 0.50 D of target.^[10] IOL selection should be individualised according to preoperative refraction, corneal astigmatism, visual needs, expectations, and lens characteristics, as emphasised by Anbalagan et al.^[11]

LIMITATIONS

The single-center study included only 100 patients, unequally distributed across four IOL groups. Nonrandomized IOL selection may have introduced baseline ocular differences or selection bias. Intermediate and near vision, spectacle dependence, contrast sensitivity, glare, halos, and patient-reported visual quality were not assessed, particularly when comparing multifocal and EDOF IOLs. The six-month follow-up precluded evaluating long-term refractive stability and late postoperative complications.

CONCLUSION

The present study demonstrates that monofocal, multifocal, EDOF, and toric IOLs provided good visual rehabilitation after phacoemulsification. Although distance outcomes were comparable, toric IOLs reduced residual astigmatism, while EDOF IOLs showed favorable refractive and visual results. Most visual-acuity differences were not statistically significant. These findings support patient-centered IOL selection based on ocular characteristics and individual visual needs.

REFERENCES

1. Cicinelli MV, Buchan JC, Nicholson M, Varadaraj V, Khanna RC. Cataracts. *Lancet*. 2023 Feb 4;401(10374):377-389. doi: 10.1016/S0140-6736(22)01839-6. Epub 2022 Dec 21. PMID: 36565712.
2. International Agency for the Prevention of Blindness. Effective cataract surgical coverage trends highlight gaps in cataract services towards 2030 targets [Internet]. London: IAPB Vision Atlas; 2026 Mar 9 [cited 2026 Sep 21]. Available from: <https://visionatlas.iapb.org>
3. TBS Report. Nearly 80% of blindness in Bangladesh caused by cataracts, 10 lakh people await surgery: Experts. The Business Standard [Internet]. 2026 Jun 30 [cited 2026 Sep 22]. Available from: <https://www.tbsnews.net/bangladesh/health/nearly-80-blindness-bangladesh-caused-ataracts-10-lakh-people-await-surgery>
4. Liu YC, Wilkins M, Kim T, Malyugin B, Mehta JS. Cataracts. *Lancet*. 2017 Aug 5;390(10094):600-612. doi: 10.1016/S0140-6736(17)30544-5. Epub 2017 Feb 25. PMID: 28242111.

5. Hossain MS, Khanom T, Arifuzzaman M, Islam MM. Comparison of visual outcome and optical quality monofocal vs monofocal plus intraocular lens. *Saudi J Med Pharm Sci*. 2024;10(12):990-4. doi: 10.36348/sjmps.2024.v10i12.017
6. el-Maghraby A, Marzouky A, Gazayerli E, Van der Karr M, DeLuca M. Multifocal versus monofocal intraocular lenses. Visual and refractive comparisons. *J Cataract Refract Surg*. 1992 Mar;18(2):147-52. doi: 10.1016/s0886-3350(13)80921-2. PMID: 1564652.
7. Amir-Asgari S, Georgiev S, Ruiss M, Plainis S, Pilwachs C, Findl O. Comparing postoperative reading performance and visual outcomes of a non-diffractive EDOF-IOL versus a monofocal IOL: a randomized controlled eye movement study. *BMC Ophthalmol*. 2025 Dec 24;25(1):694. doi: 10.1186/s12886-025-04507-9. PMID: 41444551; PMCID: PMC12729242.
8. Wang J, Luo J, Yang W, Ren R, Xie Y, Li J, et al. Efficacy and comfort following the implantation of extended depth of focus, multifocal, and monofocal intraocular lenses in cataract patients. *BMC Ophthalmol*. 2024 Sep 27;24(1):423. doi: 10.1186/s12886-024-03685-2. PMID: 39334046; PMCID: PMC11438220.
9. Wilczyński M, Topolska-Smiałowska I. Defocus curve analysis after phacoemulsification with extended depth-of-focus, multifocal, bifocal, and monofocal intraocular lenses. *Klinika Oczna / Acta Ophthalmologica Polonica*. 2026;128(2):52-59. doi: 10.5114/ko.2026.162423.
10. Hu Y, Zhu Q, Du Z, Han F, Wu Y, Li X, et al. Comparative effectiveness of toric IOLs and LRs for correction of moderate regular astigmatism during phacoemulsification. *Sci Rep*. 2025 Nov 6;15(1):38934. doi: 10.1038/s41598-025-22858-7. PMID: 41198813; PMCID: PMC12592522.
11. Anbalagan S, HariPriya A, Ravindran RD. IOLs for cataract surgery. *Community Eye Health J*. 2025;38(127):13-4. doi: 10.56920/cehj.870.
12. Islam MA, Rain MZ, Mridha MZA, Azad AK, Al-Mamun, Majumder MY. Visual outcome after cataract surgery in a tertiary eye hospital in Southern Region of Bangladesh. *Central Med Coll J*. 2024;8(1):7-11. doi: 10.3329/cemecj.v8i1.77949.
13. Hossain MS, Khanom T, Arifuzzaman M, Islam MM. Comparison of visual outcome and optical quality monofocal vs monofocal plus intraocular lens. *Saudi J Med Pharm Sci*. 2024;10(12):990-4. doi: 10.36348/sjmps.2024.v10i12.017.
14. Boz AAE, Atum M. Expanding visual horizons: comparative outcomes of bilateral implantation of an extended depth-of-focus versus enhanced and standard monofocal intraocular lenses. *BMC Ophthalmol*. 2026 Jul 8;26(1):392. doi: 10.1186/s12886-026-05096-x. PMID: 42420911.
15. Srinivasan S, Nyankerh C, Hull J, Suryakumar R. Meta-analysis of defocus curves of monofocal, enhanced monofocal and extended depth of focus intraocular lenses. *BMJ Open Ophthalmol*.

- 2025;10(1):e002025.
doi:10.1136/bmjophth-2024-002025.
16. Tañá-Sanz S, Tañá-Sanz P, Elvira-Giner B, Orts-Vila P, Tañá-Rivero P. Visual performance, light distortion and patient reported outcomes with a new bi-aspheric non-diffractive extended depth of focus intraocular lens. *Front Med*. 2025;12:1513803. doi:10.3389/fmed.2025.1513803.
 17. Agarwal S, Thomell E, Frye SN. Intermediate Vision Following Monofocal IOL Implantation. *Clin Ophthalmol*. 2025 Feb 19;19:617-627. doi: 10.2147/OPTH.S499745. PMID: 39990747; PMCID: PMC11847419.
 18. Priyamvada PV, Reddy JK, Vijayaraghavan P, Thulasidas M, Sundaram V. Comparison between opposite clear corneal incision versus toric intraocular lens in correcting astigmatism. *Indian J Ophthalmol*. 2024 Sep 1;72(9):1304-1307. doi: 10.4103/IJO.IJO_3191_23. Epub 2024 May 20. PMID: 38773910; PMCID: PMC11552809.
 19. Srinivasan S, Nyankerh C, Hull J, Suryakumar R. Meta-analysis of defocus curves of monofocal, enhanced monofocal and extended depth of focus intraocular lenses. *BMJ Open Ophthalmol*. 2025;10(1):e002025. doi:10.1136/bmjophth-2024-002025.
 20. Curran C, Adam MK. Clinical and Anatomic Outcomes of 3-Piece Poly(methyl methacrylate) Intraocular Lens Rescue and Needle-Assisted Transconjunctival Intracapsular Lens Fixation. *J Vitreoretin Dis*. 2023 Jun 5;7(5):404-411. doi: 10.1177/24741264231178377. PMID: 37706089; PMCID: PMC10496816.
 21. Gannamaneni K, Shapiro JN, Levine H, Reddy K, Armenti ST, Mian SI. Management of Post-Operative Inflammation After Cataract Surgery with Intracanalicular Dexamethasone Implant and Topical Ketorolac. *Clin Ophthalmol*. 2026 Mar 5;20:584501. doi: 10.2147/OPTH.S584501. PMID: 41809206; PMCID: PMC12970023.
 22. Zhu X, Qi J, He W, Zhang S, Zhang K, Lu Q, Lu Y. Early transient intraocular pressure spike after cataract surgery in highly myopic cataract eyes and associated risk factors. *Br J Ophthalmol*. 2020 Aug;104(8):1137-1141. doi: 10.1136/bjophthalmol-2019-315117. Epub 2019 Nov 8. PMID: 31704699.
 23. Horn JD, Fisher BL, Terveen D, Fevrier H, Merchea M, Gu X. Academy IRIS® Registry Analysis of Incidence of Laser Capsulotomy Due to Posterior Capsule Opacification After Intraocular Lens Implantation. *Clin Ophthalmol*. 2022 Jun 1;16:1721-1730. doi: 10.2147/OPTH.S358059. PMID: 35673348; PMCID: PMC9167596.