



Comparative Evaluation of Hydrophobic and Hydrophilic Foldable Intraocular Lenses on Visual Outcomes Following Phacoemulsification Cataract Surgery

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Abstract

Objective: To determine whether hydrophobic or hydrophilic foldable intraocular lenses provide superior postoperative visual outcomes following phacoemulsification cataract surgery.

Materials and Methods: This prospective comparative study was conducted in the Department of Ophthalmology, Government Medical College, Patiala. A total of 220 patients undergoing phacoemulsification were included and randomly assigned to two groups based on IOL type: hydrophilic foldable IOL (n = 100) and hydrophobic foldable IOL (n = 120). The hydrophilic group included Hydrofold and Acryfold lenses, while the hydrophobic group included Supraphob, Aurovue, and AcrySof IQ lenses. Postoperative evaluation was performed at multiple follow-up intervals up to 6 months, assessing uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), best corrected near visual acuity (BCNVA), spherical equivalent, and intraocular pressure (IOP).

Results: Both groups demonstrated significant improvement in visual outcomes postoperatively. At 6 months, excellent BCVA (6/6-6/6p) was achieved in 83.0% of hydrophilic and 82.5% of hydrophobic IOL cases, with no statistically significant difference between groups ($p > 0.05$). UCVA and BCNVA also improved markedly in both groups, with the majority achieving optimal vision. Refractive outcomes showed excellent predictability, with spherical equivalent values approaching emmetropia (-0.03 D) in both groups. Intraocular pressure remained stable and within physiological limits throughout follow-up. No statistically significant differences were observed between groups across all parameters ($p > 0.05$). Cost-effectiveness analysis revealed that hydrophilic IOLs (Acryfold, Hydrofold) provided better economic value compared to premium hydrophobic lenses.

Conclusion: Both hydrophilic and hydrophobic foldable intraocular lenses provide comparable and satisfactory visual, refractive, and safety outcomes following phacoemulsification. The choice of IOL material may therefore be guided by cost, availability, and surgeon preference rather than differences in clinical outcomes.

Keywords: Lens; Crystalline; Phacoemulsification; Intraocular Lens (IOL)

Introduction

The crystalline human lens is a highly specialized transparent structure responsible for focusing light onto the retina and contributing approximately +15 Diopter to the total refractive power of the eye, which is about 58 Diopter overall. While the cornea provides the majority of refractive power, the lens plays a crucial role in accommodation by adjusting its shape to ensure clear image formation on the retina [1-3].

Cataract, defined as opacification of the crystalline lens, remains one of the leading causes of blindness and visual impairment worldwide, especially in developing and ageing populations. It may be congenital or acquired, with age-related cataracts being the most common. These are further classified into nuclear, cortical, and posterior subcapsular types based on the location of opacity within the lens [4].

Despite cataract surgery being an effective treatment, the high volume of procedures contributes significantly to healthcare costs. Therefore, identifying modifiable risk factors and preventive strategies remains important for reducing the global burden of cataract-related visual impairment [5].

With the progression of cataract, surgical removal of the opacified lens becomes necessary to restore vision. Replacement of the natural lens with an intraocular lens (IOL) is essential to re-establish the refractive power of the eye and achieve optimal postoperative visual outcomes [2].

The evolution of cataract surgery has progressed from ancient techniques like couching to modern phacoemulsification. Historical milestones include extracapsular cataract extraction by Sushruta, intracapsular extraction by Samuel Sharp, and the introduction of phacoemulsification by Charles Kelman in 1967, which enabled smaller incisions and faster recovery [6-10].

Advancements in IOL technology began with Sir Harold Ridley's introduction of PMMA lenses and have since evolved to foldable lenses that allow small-incision surgery. Modern cataract surgery is now considered a refractive procedure, focusing not only on restoring vision but also on achieving high visual quality, refractive precision, and long-term stability [9].

IOL materials, particularly hydrophilic and hydrophobic acrylic lenses, differ in water content, refractive index, and capsular biocompatibility, influencing outcomes such as glare and posterior capsular opacification (PCO). While hydrophobic acrylic lenses are associated with lower PCO rates, hydrophilic acrylic lenses have low refractive index, resulting in theoretically decreased glare and other distortion by lens. Visual acuity, commonly assessed using the Snellen chart, remains the primary parameter for evaluating postoperative outcomes, although it is influenced by multiple anatomical and optical factors [11-15].

Materials and Methods

This prospective comparative study was conducted in the Department of Ophthalmology, Government Medical College, Patiala. A total of 220 patients with cataract undergoing phacoemulsification were included. Patients were randomly divided into two groups based on intraocular lens (IOL) type: hydrophobic (120 cases) and hydrophilic (100 cases) IOLs. The hydrophobic IOL group was further subdivided into three equal subgroups (Supra Phob foldable IOL [SPNT300, Appasamy Ocular Devices (P) Ltd, Vadamangalam, Puducherry, India], Aurovue foldable IOL [HP7600, Aurolab, Verrapanjan, Madurai, India], and AcrySof IQ foldable IOL [SN60WF, Alcon Laboratories, Inc., Texas, USA], while the hydrophilic IOL group included two subgroups (Hydrofold foldable IOL [SQRYCF, Caregroup Sight Solution Limited, Vadodara, Gujarat, India], and Acryfold foldable IOL [601, Appasamy Ocular Devices (P) Ltd, Vadamangalam, Puducherry, India].

Patients aged 18 - 90 years with uncomplicated cataracts and normal preoperative findings were included. Those with secondary cataracts, prior intraocular surgery, active ocular diseases, or postoperative complications were excluded. All patients underwent detailed ophthalmic evaluation including visual acuity assessment, refraction, intraocular pressure measurement, slit-lamp and fundus examination, keratometry, A-scan biometry, and IOL power calculation. Necessary systemic investigations were also performed.

All patients underwent phacoemulsification under local anaesthesia using a standardized technique. After aseptic preparation and pupillary dilatation, a clear corneal incision was made, followed by capsulorrhexis, hydrodissection, and

phacoemulsification. Cortical cleanup was performed, and a foldable IOL was implanted in the capsular bag. The procedure concluded with stromal hydration and administration of subconjunctival antibiotics and steroids.

Patients were examined on postoperative day 1 for corneal edema and IOL position using a slit lamp. Subsequent follow-ups were conducted on day 7, and at 1, 3, and 6 months. At each visit, uncorrected and best-corrected visual acuity (distance and near), refraction, intraocular pressure, and keratometry readings were assessed to evaluate visual outcomes.

Data were recorded in Microsoft Excel and analyzed using IBM SPSS version 25. Categorical variables were expressed as frequency and percentage, while continuous variables were presented as mean ± standard deviation. Chi-square test, independent t-test, and one-way ANOVA were used for comparisons. Visual acuity

outcomes were converted into ordinal scores and analyzed over multiple follow-ups using the Friedman test, with a p-value < 0.05 considered statistically significant.

Results

This study was conducted in the Department of Ophthalmology at Government Medical College and Rajindra Hospital, Patiala, and included a total of 220 patients. It was designed as a prospective comparative study involving patients diagnosed with cataract and scheduled for phacoemulsification surgery.

The patients were randomly allocated into two groups based on the type of intraocular lens (IOL) implanted: hydrophobic and hydrophilic foldable IOL groups. The hydrophobic foldable IOL group was further subdivided into three subgroups: Supraphob, AcrySof IQ, and Aurovue IOLs. The hydrophilic foldable IOL group was divided into two subgroups: Acryfold and Hydrofold IOLs.

Age group	Hydrophilic (n = 100)	Percentage	Hydrophobic (n = 120)	Percentage	Total (n = 220)	Percentage
26 - 35 years	1	1.00%	3	2.50%	4	1.80%
36 - 45 years	7	7.00%	9	7.50%	16	7.30%
46 - 55 years	18	18.00%	28	23.30%	46	20.90%
56 - 65 years	55	55.00%	47	39.20%	102	46.40%
66 - 75 years	17	17.00%	30	25.00%	47	21.40%
76 - 85 years	2	2.00%	3	2.50%	5	2.30%
Mean ± SD	60.10 ± 8.58		59.60 ± 10.60			
Median	61 years		60 years			
Range	32 - 79 years		26 - 85 years			
p-value#	0.68					

Table 1: Age distribution in hydrophilic and hydrophobic IOL groups.

#Independent t-test.

The majority of patients in both hydrophilic and hydrophobic IOL groups were in the 56 - 65 years age group. The mean age was comparable between the hydrophilic (60.10 ± 8.58 years) and hydrophobic (59.60 ± 10.60 years) groups. There was no statistically significant difference in age distribution between the two groups (independent ttest, p = 0.68), indicating that the groups were age-matched.

Females constituted a higher proportion in both hydrophilic (60.0%) and hydrophobic (53.3%) IOL groups, while males accounted for 40.0% and 46.7%, respectively. The overall female predominance was 56.4%. There was no statistically significant difference in sex distribution between the two groups ($\chi^2 = 0.96$, p = 0.327), indicating comparable gender distribution.

Sex	Hydrophilic (n = 100)	Hydrophilic (%)	Hydrophobic (n = 120)	Hydrophobic (%)	Total (n = 220)	Total (%)	χ^2	p value
Female	60	60.00%	64	53.30%	124	56.40%	0.96	0.327
Male	40	40.00%	56	46.70%	96	43.60%		
Total	100	100%	120	100%	220	100%		

Table 2: Sex distribution in hydrophobic and hydrophilic IOL groups.

Time Point	UCVA	Hydrophilic (n = 100)	Hydrophilic (%)	Hydrophobic (n = 120)	Hydrophobic (%)	Total (n = 220)	Total (%)	χ^2	p value
Pre-Operative	6/6-6/6p	0	0.00%	0	0.00%	0	0.00%	2.94	0.23
	6/9-6/9p	0	0.00%	0	0.00%	0	0.00%		
	6/12-6/18	28	28.00%	23	19.20%	51	23.20%		
	6/24-6/36	41	41.00%	63	52.50%	104	47.30%		
	≤6/60	31	31.00%	34	28.30%	65	29.50%		
	Total	100	100%	120	100%	220	100%		
Post-Operative 1 Week	6/6-6/6P	48	48.00%	54	45.00%	102	46.40%	2.16	0.339
	6/9-6/9P	45	45.00%	50	41.70%	95	43.20%		
	6/12-6/18	7	7.00%	16	13.30%	23	10.50%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	100	100%	120	100%	220	100%		
Post-Operative 1 Month	6/6-6/6P	55	55.00%	66	55.00%	121	55.00%	0.2	0.904
	6/9-6/9P	39	39.00%	45	37.50%	84	38.20%		
	6/12-6/18	6	6.00%	9	7.50%	15	6.80%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	100	100%	120	100%	220	100%		
Post-Operative 3 Month	6/6-6/6P	62	62.00%	72	60.00%	134	60.90%	0.18	0.913
	6/9-6/9P	33	33.00%	40	33.30%	73	33.20%		
	6/12-6/18	5	5.00%	8	6.70%	13	5.90%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	100	100%	120	100%	220	100%		
Post-Operative 6 Month	6/6-6/6P	63	63.00%	73	60.80%	136	61.80%	0.14	0.933
	6/9-6/9P	32	32.00%	40	33.30%	72	32.70%		
	6/12-6/18	5	5.00%	7	5.80%	12	5.50%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	100	100%	120	100%	220	100%		

Table 3: UCVA trend comparison of hydrophobic and hydrophilic IOL (Pre-operative to post-operative 6 months).

Friedman test: Hydrophilic $\chi^2 = 507.19$, $p < 0.001$ | Hydrophobic $\chi^2 = 597.44$, $p < 0.001$.

Time Point	UCVA	AcrySof IQ (n = 40)	AcrySof IQ (%)	Aurovue (n = 40)	Aurovue (%)	Supra-phob (n = 40)	Supra-phob (%)	Total (n = 120)	Total (%)	χ^2	p value
Pre-Operative	6/6-6/6p	0	0.00%	0	0.00%	0	0.00%	0	0.00%	6.28	0.179
	6/9-6/9p	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	6/12-6/18	9	22.50%	6	15.00%	8	20.00%	23	19.20%		
	6/24-6/36	19	47.50%	27	67.50%	17	42.50%	63	52.50%		
	≤6/60	12	30.00%	7	17.50%	15	37.50%	34	28.30%		
	Total	40	100%	40	100%	40	100%	120	100%		
Post-Operative 1 Week	6/6-6/6P	20	50.00%	17	42.50%	17	42.50%	54	45.00%	2.25	0.689
	6/9-6/9P	16	40.00%	18	45.00%	16	40.00%	50	41.70%		
	6/12-6/18	4	10.00%	5	12.50%	7	17.50%	16	13.30%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	Total	40	100%	40	100%	40	100%	120	100%		
Post-Operative 1 Month	6/6-6/6P	23	57.50%	21	52.50%	22	55.00%	66	55.00%	1.66	0.797
	6/9-6/9P	15	37.50%	17	42.50%	13	32.50%	45	37.50%		
	6/12-6/18	2	5.00%	2	5.00%	5	12.50%	9	7.50%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	Total	40	100%	40	100%	40	100%	120	100%		
Post-Operative 3 Month	6/6-6/6P	23	57.50%	24	60.00%	25	62.50%	72	60.00%	1.18	0.882
	6/9-6/9P	15	37.50%	14	35.00%	11	27.50%	40	33.30%		
	6/12-6/18	2	5.00%	2	5.00%	4	10.00%	8	6.70%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	Total	40	100%	40	100%	40	100%	120	100%		
Post-Operative 6 Month	6/6-6/6P	23	57.50%	25	62.50%	25	62.50%	73	60.80%	1.57	0.814
	6/9-6/9P	16	40.00%	13	32.50%	11	27.50%	40	33.30%		
	6/12-6/18	1	2.50%	2	5.00%	4	10.00%	7	5.80%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	Total	40	100%	40	100%	40	100%	120	100%		

Table 4: UCVA trend comparison in hydrophobic IOL (Pre-op to 6 months).

Friedman test: AcrySof IQ $\chi^2 = 215.48$, $p < 0.001$ | Aurovue $\chi^2 = 192.14$, $p < 0.001$ | Supraphob $\chi^2 = 193.44$, $p < 0.001$.

Time Point	UCVA	Acryfold (n = 50)	Acryfold (%)	Hydrofold (n = 50)	Hydrofold (%)	Total (n = 100)	Total (%)	χ^2	p value
Pre-Operative	6/6-6/6p	0	0.00%	0	0.00%	0	0.00%	1.05	0.592
	6/9-6/9p	0	0.00%	0	0.00%	0	0.00%		
	6/12-6/18	13	26.00%	15	30.00%	28	28.00%		
	6/24-6/36	23	46.00%	18	36.00%	41	41.00%		
	≤6/60	14	28.00%	17	34.00%	31	31.00%		
	Total	50	100%	50	100%	100	100%		
Post-Operative 1 Week	6/6-6/6P	22	44.00%	26	52.00%	48	48.00%	1.5	0.472
	6/9-6/9P	23	46.00%	22	44.00%	45	45.00%		
	6/12-6/18	5	10.00%	2	4.00%	7	7.00%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	50	100%	50	100%	100	100%		
Post-Operative 1 Month	6/6-6/6P	26	52.00%	29	58.00%	55	55.00%	0.74	0.69
	6/9-6/9P	20	40.00%	19	38.00%	39	39.00%		
	6/12-6/18	4	8.00%	2	4.00%	6	6.00%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	50	100%	50	100%	100	100%		
Post-Operative 3 Month	6/6-6/6P	31	62.00%	31	62.00%	62	62.00%	0.1	0.951
	6/9-6/9P	16	32.00%	17	34.00%	33	33.00%		
	6/12-6/18	3	6.00%	2	4.00%	5	5.00%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	50	100%	50	100%	100	100%		
Post-Operative 6 Month	6/6-6/6P	31	62.00%	32	64.00%	63	63.00%	0.08	0.96
	6/9-6/9P	16	32.00%	16	32.00%	32	32.00%		
	6/12-6/18	3	6.00%	2	4.00%	5	5.00%		
	6/24-6/36	0	0.00%	0	0.00%	0	0.00%		
	≤6/60	0	0.00%	0	0.00%	0	0.00%		
	Total	50	100%	50	100%	100	100%		

Table 5: UCVA trend comparison in hydrophilic IOL (Pre-op to 6 months).

Friedman test: Acryfold $\chi^2 = 245.92$, $p < 0.001$ | Hydrofold $\chi^2 = 263.30$, $p < 0.001$.

UCVA showed significant improvement in both hydrophilic and hydrophobic IOL groups from the early postoperative period, with most patients achieving 6/6-6/9 vision by 1 month and stable outcomes up to 6 months. No statistically significant difference in UCVA was observed between the two groups or within hydrophilic

subtypes at any followup interval ($p > 0.05$), indicating comparable uncorrected visual outcomes.

BCVA improved significantly in both hydrophilic and hydrophobic IOL groups from the early postoperative period, with

Time Point	BCVA	Hydrophilic	Hydrophobic	Total n (%)	χ^2	p value
Pre-Operative	6/6-6/6p	0 (0%)	0 (0%)	0 (0%)	1.41	0.495
	6/9-6/9p	0 (0%)	0 (0%)	0 (0%)		
	6/12-6/18	64 (64.0%)	69 (57.5%)	133 (60.5%)		
	6/24-6/36	29 (29.0%)	44 (36.7%)	73 (33.2%)		
	≤6/60	7 (7.0%)	7 (5.8%)	14 (6.4%)		
	Total	100 (100%)	120 (100%)	220 (100%)		
Post-Operative 1 Week	6/6-6/6P	49 (49.0%)	57 (47.5%)	106 (48.2%)	0.46	0.793
	6/9-6/9P	45 (45.0%)	53 (44.2%)	98 (44.5%)		
	6/12-6/18	6 (6.0%)	10 (8.3%)	16 (7.3%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	100 (100%)	120 (100%)	220 (100%)		
Post-Operative 1 Month	6/6-6/6P	78 (78.0%)	94 (78.3%)	172 (78.2%)	0.35	0.839
	6/9-6/9P	18 (18.0%)	19 (15.8%)	37 (16.8%)		
	6/12-6/18	4 (4.0%)	7 (5.8%)	11 (5.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	100 (100%)	120 (100%)	220 (100%)		
Post-Operative 3 Month	6/6-6/6P	82 (82.0%)	98 (81.7%)	180 (81.8%)	0.26	0.878
	6/9-6/9P	14 (14.0%)	15 (12.5%)	29 (13.2%)		
	6/12-6/18	4 (4.0%)	7 (5.8%)	11 (5.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	100 (100%)	120 (100%)	220 (100%)		
Post-Operative 6 Month	6/6-6/6P	83 (83.0%)	99 (82.5%)	182 (82.7%)	0.16	0.923
	6/9-6/9P	13 (13.0%)	15 (12.5%)	28 (12.7%)		
	6/12-6/18	4 (4.0%)	6 (5.0%)	10 (4.5%)		
	Total	100 (100%)	120 (100%)	220 (100%)		

Table 6: BCVA trend comparison of hydrophobic and hydrophilic IOL (Pre-operative to post-operative 6 months).

Friedman test: Hydrophilic $\chi^2 = 507.19$, $p < 0.001$ | Hydrophobic $\chi^2 = 597.44$, $p < 0.001$.

Time Point	BCVA	Acryfold	Hydrofold	Total n (%)	χ^2	p value
Pre-Operative	6/6-6/6p	0 (0%)	0 (0%)	0 (0%)	1.89	0.388
	6/9-6/9p	0 (0%)	0 (0%)	0 (0%)		
	6/12-6/18	35 (70.0%)	29 (58.0%)	64 (64.0%)		
	6/24-6/36	13 (26.0%)	16 (32.0%)	29 (29.0%)		
	≤6/60	2 (4.0%)	5 (10.0%)	7 (7.0%)		
	Total	50 (100%)	50 (100%)	100 (100%)		

Post-Operative 1 Week	6/6-6/6P	22 (44.0%)	27 (54.0%)	49 (49.0%)	1.17	0.557
	6/9-6/9P	24 (48.0%)	21 (42.0%)	45 (45.0%)		
	6/12-6/18	4 (8.0%)	2 (4.0%)	6 (6.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	50 (100%)	50 (100%)	100 (100%)		
Post-Operative 1 Month	6/6-6/6P	39 (78.0%)	39 (78.0%)	78 (78.0%)	1.04	0.594
	6/9-6/9P	8 (16.0%)	10 (20.0%)	18 (18.0%)		
	6/12-6/18	3 (6.0%)	1 (2.0%)	4 (4.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	50 (100%)	50 (100%)	100 (100%)		
Post-Operative 3 Month	6/6-6/6P	42 (84.0%)	40 (80.0%)	82 (82.0%)	1.17	0.557
	6/9-6/9P	5 (10.0%)	9 (18.0%)	14 (14.0%)		
	6/12-6/18	3 (6.0%)	1 (2.0%)	4 (4.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	50 (100%)	50 (100%)	100 (100%)		
Post-Operative 6 Month	6/6-6/6P	43 (86.0%)	40 (80.0%)	83 (83.0%)	1.89	0.388
	6/9-6/9P	4 (8.0%)	9 (18.0%)	13 (13.0%)		
	6/12-6/18	3 (6.0%)	1 (2.0%)	4 (4.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)		
	Total	50 (100%)	50 (100%)	100 (100%)		

Table 7: BCVA trend comparison in hydrophilic IOL (Pre-op to 6 months).

Friedman test: Acryfold $\chi^2 = 220.98$, $p < 0.001$ | Hydrofold $\chi^2 = 242.13$, $p < 0.001$.

Time Point	BCVA	AcrySof IQ	Aurovue	Supraphob	Total n (%)	χ^2	p value
Pre-op	6/6-6/6p	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3.06	0.548
	6/9-6/9p	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	6/12-6/18	22 (55.0%)	22 (55.0%)	25 (62.5%)	69 (57.5%)		
	6/24-6/36	16 (40.0%)	17 (42.5%)	11 (27.5%)	44 (36.7%)		
	≤6/60	2 (5.0%)	1 (2.5%)	4 (10.0%)	7 (5.8%)		
	Total	40 (100%)	40 (100%)	40 (100%)	120 (100%)		

Post-Operative 1 Week	6/6-6/6P	21 (52.5%)	17 (42.5%)	19 (47.5%)	57 (47.5%)	2.38	0.666
	6/9-6/9P	17 (42.5%)	20 (50.0%)	16 (40.0%)	53 (44.2%)		
	6/12-6/18	2 (5.0%)	3 (7.5%)	5 (12.5%)	10 (8.3%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	Total	40 (100%)	40 (100%)	40 (100%)	120 (100%)		
Post-Operative 1 Month	6/6-6/6P	33 (82.5%)	30 (75.0%)	31 (77.5%)	94 (78.3%)	1.22	0.873
	6/9-6/9P	5 (12.5%)	8 (20.0%)	6 (15.0%)	19 (15.8%)		
	6/12-6/18	2 (5.0%)	2 (5.0%)	3 (7.5%)	7 (5.8%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	Total	40 (100%)	40 (100%)	40 (100%)	120 (100%)		
Post-Operative 3 Month	6/6-6/6P	35 (87.5%)	31 (77.5%)	32 (80.0%)	98 (81.7%)	1.38	0.847
	6/9-6/9P	3 (7.5%)	7 (17.5%)	5 (12.5%)	15 (12.5%)		
	6/12-6/18	2 (5.0%)	2 (5.0%)	3 (7.5%)	7 (5.8%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	Total	40 (100%)	40 (100%)	40 (100%)	120 (100%)		
Post-Operative 6 Month	6/6-6/6P	35 (87.5%)	31 (77.5%)	33 (82.5%)	99 (82.5%)	1.06	0.900
	6/9-6/9P	4 (10.0%)	7 (17.5%)	4 (10.0%)	15 (12.5%)		
	6/12-6/18	1 (2.5%)	2 (5.0%)	3 (7.5%)	6 (5.0%)		
	6/24-6/36	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	≤6/60	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
	Total	40 (100%)	40 (100%)	40 (100%)	120 (100%)		

Table 8: BCVA trend comparison in hydrophobic IOL (Pre-op to 6 months).

Friedman test: AcrySof IQ $\chi^2 = 187.17$, $p < 0.001$ | Aurovue $\chi^2 = 183.91$, $p < 0.001$ | Supraphob $\chi^2 = 181.29$, $p < 0.001$.

most patients achieving 6/6-6/9 vision by 1 month and further stabilization up to 6 months. No statistically significant difference in BCVA was observed between hydrophilic and hydrophobic

IOLs or among their respective subtypes at any followup interval ($p > 0.05$), indicating comparable and sustained visual outcomes across all IOLs.

Time Point	BCNVA	Hydrophilic (n)	Hydrophilic (%)	Hydrophobic (n)	Hydrophobic (%)	Total (n)	Total (%)	χ^2	p value
Pre-op	N6	0	0.00%	0	0.00%	0	0.00%	7.46	0.113
	N8	7	7.00%	17	14.20%	24	10.90%		
	N10	20	20.00%	39	32.50%	59	26.80%		
	N12	41	41.00%	35	29.20%	76	34.50%		
	N14	20	20.00%	19	15.80%	39	17.70%		
	N18	12	12.00%	10	8.30%	22	10.00%		
1 Week	N6	69	69.00%	89	74.20%	158	71.80%	1.03	0.794
	N8	17	17.00%	16	13.30%	33	15.00%		
	N10	10	10.00%	11	9.20%	21	9.50%		
	N12	4	4.00%	4	3.30%	8	3.60%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
1 Month	N6	84	84.00%	98	81.70%	182	82.70%	6.44	0.092
	N8	6	6.00%	13	10.80%	19	8.60%		
	N10	5	5.00%	9	7.50%	14	6.40%		
	N12	5	5.00%	0	0.00%	5	2.30%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
3 Months	N6	85	85.00%	103	85.80%	188	85.50%	0.58	0.748
	N8	8	8.00%	11	9.20%	19	8.60%		
	N10	7	7.00%	6	5.00%	13	5.90%		
	N12	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
6 Months	N6	88	88.00%	104	86.70%	192	87.30%	1.44	0.487
	N8	6	6.00%	12	10.00%	18	8.20%		
	N10	6	6.00%	4	3.30%	10	4.50%		
	N12	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		

Table 9: BCNVA trend comparison of hydrophobic and hydrophilic IOL (Pre-operative to post-operative 6 months).

Friedman test: Hydrophilic $\chi^2 = 439.51$, $p < 0.001$ | Hydrophobic $\chi^2 = 549.00$, $p < 0.001$.

Time Point	BCNVA	Acryfold (n)	Acryfold (%)	Hydrofold (n)	Hydrofold (%)	Total (n)	Total (%)	χ^2	p value
Pre-Operative	N6	0	0.00%	0	0.00%	0	0.00%	0.83	0.934
	N8	4	8.00%	3	6.00%	7	7.00%		
	N10	10	20.00%	10	20.00%	20	20.00%		
	N12	21	42.00%	20	40.00%	41	41.00%		
	N14	10	20.00%	10	20.00%	20	20.00%		
	N18	5	10.00%	7	14.00%	12	12.00%		
Post-Operative 1 Week	N6	37	74.00%	32	64.00%	69	69.00%	3.72	0.293
	N8	5	10.00%	12	24.00%	17	17.00%		
	N10	6	12.00%	4	8.00%	10	10.00%		
	N12	2	4.00%	2	4.00%	4	4.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
Post-Operative 1 Month	N6	41	82.00%	43	86.00%	84	84.00%	1.61	0.657
	N8	3	6.00%	3	6.00%	6	6.00%		
	N10	4	8.00%	1	2.00%	5	5.00%		
	N12	2	4.00%	3	6.00%	5	5.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
Post-Operative 3 Month	N6	43	86.00%	42	84.00%	85	85.00%	0.23	0.892
	N8	4	8.00%	4	8.00%	8	8.00%		
	N10	3	6.00%	4	8.00%	7	7.00%		
	N12	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
Post-Operative 6 Month	N6	44	88.00%	44	88.00%	88	88.00%	0	1
	N8	3	6.00%	3	6.00%	6	6.00%		
	N10	3	6.00%	3	6.00%	6	6.00%		
	N12	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%		
Total		50	100%	50	100%	100	100%		

Table 10: BCNVA trend in hydrophilic IOL (Pre-op to 6 months).

Friedman test: Acryfold $\chi^2 = 211.74$, $p < 0.001$ | Hydrofold $\chi^2 = 228.20$, $p < 0.001$.

Time Point	BCNVA	AcrySof IQ (n)	AcrySof IQ (%)	Aurovue (n)	Aurovue (%)	Supra-phob (n)	Supra-phob (%)	Total (n)	Total (%)	χ^2	p value
Pre-op	N6	0	0.00%	0	0.00%	0	0.00%	0	0.00%	13.21	0.104
	N8	6	15.00%	9	22.50%	2	5.00%	17	14.20%		
	N10	9	22.50%	16	40.00%	10	25.00%	35	29.20%		
	N12	13	32.50%	10	25.00%	16	40.00%	39	32.50%		
	N14	8	20.00%	2	5.00%	9	22.50%	19	15.80%		
	N18	4	10.00%	3	7.50%	3	7.50%	10	8.30%		
1 Week	N6	32	80.00%	27	67.50%	30	75.00%	89	74.20%	2.32	0.886
	N8	4	10.00%	7	17.50%	5	12.50%	16	13.30%		
	N10	3	7.50%	4	10.00%	4	10.00%	11	9.20%		
	N12	1	2.50%	2	5.00%	1	2.50%	4	3.30%		
	N14	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
1 Month	N6	35	87.50%	32	80.00%	31	77.50%	98	81.70%	2.63	0.853
	N8	3	7.50%	4	10.00%	6	15.00%	13	10.80%		
	N10	2	5.00%	4	10.00%	3	7.50%	9	7.50%		
	N12	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	N18	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
3 Months	N6	35	87.50%	34	85.00%	34	85.00%	103	85.80%	0.74	0.946
	N8	3	7.50%	3	7.50%	5	12.50%	11	9.20%		
	N10	2	5.00%	3	7.50%	1	2.50%	6	5.00%		
	N12	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%				
	N18	0	0.00%	0	0.00%	0	0.00%				
6 Months	N6	35	87.50%	35	87.50%	34	85.00%	104	86.70%	0.56	0.967
	N8	4	10.00%	3	7.50%	5	12.50%	12	10.00%		
	N10	1	2.50%	2	5.00%	1	2.50%	4	3.30%		
	N12	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	N14	0	0.00%	0	0.00%	0	0.00%				
	N18	0	0.00%	0	0.00%	0	0.00%				
Total		40	100%	40	100%	40	100%	120	100%		

Table 11: BCNVA trend in hydrophobic IOL (Pre-op to 6 months).

Friedman test: AcrySof IQ $\chi^2 = 189.97$, $p < 0.001$ | Aurovue $\chi^2 = 173.75$, $p < 0.001$ | Supraphob $\chi^2 = 187.93$, $p < 0.001$.

BCNVA showed significant improvement in both hydrophilic and hydrophobic IOL groups from the early postoperative period, with progressive gains up to 6 months. The majority of patients achieved N6 near vision by 1 month, which further increased and stabilized by 6 months. No statistically significant difference in BCNVA was observed between hydrophilic and hydrophobic IOLs or among their respective subtypes at any followup interval ($p > 0.05$), indicating comparable nearvision outcomes across all IOLs.

Time Point	Hydrophilic (n = 100)	Hydrophobic (n = 120)	p-value#
Pre-Operative	-0.41 D ± 1.30	-0.35 D ± 1.32	0.739
Post-Operative 1 Month	-0.04 D ± 0.12	-0.04 D ± 0.13	0.884
Post-Operative 3 Months	-0.03 D ± 0.12	-0.03 D ± 0.13	0.950
Post-Operative 6 Months	-0.03 D ± 0.12	-0.03 D ± 0.13	0.892

Table 12: Comparison of spherical equivalent (Mean ± SD) between hydrophilic and hydrophobic IOLs.
Independent t-test.

Time Point	Acryfold (n = 50)	Hydrofold (n = 50)	p-value#
Pre-Operative	-0.51 D ± 1.23	-0.32 D ± 1.36	0.460
Post-Operative 1 Month	-0.03 D ± 0.13	-0.04 D ± 0.11	0.837
Post-Operative 3 Months	-0.03 D ± 0.12	-0.04D ± 0.11	0.750
Post-Operative 6 Months	-0.03 D ± 0.13	-0.03D ± 0.11	1.000

Table 13: Comparison of spherical equivalent (Mean ± SD) in hydrophilic IOL.
#Independent t-test.

Time Point	Supraphob (n = 40)	AcrySof IQ (n = 40)	Aurovue (n = 40)	p-value#
Pre-Operative	-0.58 D ± 1.47	-0.28 D ± 1.48	-0.19 D ± 0.95	0.385
Post-Operative 1 Month	-0.05D ± 0.14	-0.02 D ± 0.12	-0.04 D ± 0.14	0.502
Post-Operative 3 Months	-0.04 D ± 0.13	-0.02 D ± 0.12	-0.03 D ± 0.14	0.798
Post-Operative 6 Months	-0.03 D ± 0.14	-0.02 D ± 0.12	-0.04 D ± 0.13	0.795

Table 14: Comparison of spherical equivalent (Mean ± SD) among hydrophobic IOLs.
#ANOVA.

The spherical equivalent was comparable between hydrophilic and hydrophobic IOL groups at all pre and postoperative followup intervals, with no statistically significant differences observed ($p > 0.05$). Similarly, no significant variation in refractive outcomes was noted within hydrophilic IOL subtypes or among different hydrophobic IOLs, indicating good refractive stability across all lens types.

Time Point	Hydrophilic (n = 100)	Hydrophobic (n = 120)	p-value#
Pre-Operative	14.10 mmHg ± 3.07	14.10 mmHg ± 3.19	0.919
Post-Operative 1 Week	13.30 mmHg ± 2.92	13.60 mmHg ± 2.94	0.603
Post-Operative 1 Month	13.70 mmHg ± 2.98	13.50 mmHg ± 2.98	0.736
Post-Operative 3 Months	13.30 mmHg ± 2.88	13.40 mmHg ± 2.87	0.822
Post-Operative 6 Months	13.40 mmHg ± 2.50	13.50 mmHg ± 2.75	0.765

Table 15: Intraocular pressure (IOP) (Mean ± SD) comparison between hydrophilic and hydrophobic IOLs.
#Independent t-test.

Time Point	Hydrofold (n = 50)	Acryfold (n = 50)	p-value#
Pre-Operative	14.10 mmHg ± 3.07	14.10 mmHg ± 3.19	0.919
Post-Operative 1 Week	13.30 mmHg ± 2.92	13.60 mmHg ± 2.94	0.603
Post-Operative 1 Month	13.70 mmHg ± 2.98	13.50 mmHg ± 2.98	0.736
Post-Operative 3 Months	13.30 mmHg ± 2.88	13.40 mmHg ± 2.87	0.822
Post-Operative 6 Months	13.40 mmHg ± 2.50	13.50 mmHg ± 2.75	0.765

Table 16: Comparison of intraocular pressure (IOP) (Mean ± SD) in hydrophilic IOL.
#Independent t-test.

Time Point	Supraphob (n = 40)	AcrySof IQ (n = 40)	Aurovue (n = 40)	p-value#
Pre-Operative	14.70 mmHg ± 2.69	15.00 mmHg ± 3.06	14.20 mmHg ± 2.98	0.427
Post-Operative 1 Week	13.50 mmHg ± 3.03	14.30 mmHg ± 3.36	14.50 mmHg ± 3.10	0.295

Post-Operative 1 Month	14.10 mmHg ± 2.78	13.80 mmHg ± 2.70	13.70 mmHg ± 3.20	0.839
Post-Operative 3 Months	13.80 mmHg ± 2.82	14.10 mmHg ± 2.85	13.60 mmHg ± 2.46	0.641
Post-Operative 6 Months	13.60 mmHg ± 2.50	14.80 mmHg ± 3.36	13.70 mmHg ± 1.68	0.142

Table 17: Comparison of intraocular pressure (IOP) (Mean ± SD) among hydrophobic IOLs.

#ANOVA.

Mean intraocular pressure remained stable and comparable between hydrophilic and hydrophobic IOL groups throughout the 6month followup. No statistically significant differences were observed between IOL types or subtypes at any time point ($p > 0.05$), indicating a similar and safe IOP profile across all lenses.

Parameter	Hydrofold (n = 50) (MRP = Rs 5000 / \$55.55)	Acryfold (n = 50) (MRP = Rs 4500 / \$50)	Supraphob (n = 40) (MRP = Rs 10000 / \$111.11)	AcrySof IQ (n = 40) (MRP = Rs 10900 / \$121.11)	Aurovue (n = 40) (MRP = Rs6540 / \$72.66)
Mean Cost per patient	Rs 100 (\$1.11)	Rs 90 (\$1)	Rs 250 (\$2.77)	Rs.272.50 (\$3.02)	Rs 163.5 (\$1.81)
Visual acuity at 6 months (BCVA 6/6-6/6P) (Per Person)	43 out of 50 (86.0%)	40 out of 50 (80%)	33 out of 40 (82.5%)	35 out of 40 (87.5%)	31 out of 40 (77.5%)
CEA (Cost Effectiveness Ratio)	Rs 112.50 (\$1.25)	Rs 116.28 (\$1.29)	Rs 210.97 (\$ 2.34)	Rs 303.03 (\$ 3.36)	Rs 311.43 (\$ 3.46)

Table 18: Cost effective analysis @ USD: INR :: 1:90.

Among all five IOLs evaluated, Acryfold demonstrated the best cost-effectiveness with the lowest cost per successful visual outcome (Rs 112.50), despite a slightly lower effectiveness compared to some premium lenses, while Hydrofold ranked second by combining high visual success (86%) with a low procedural cost, making it highly suitable for high-volume and resource-limited settings. Aurovue showed moderate cost-effectiveness, performing better than premium lenses but inferior to both hydrophilic options, whereas Supraphob and AcrySof IQ, although associated with good visual outcomes, had significantly higher costs resulting in poorer cost-effectiveness ratios.

Discussion

The present study compared postoperative visual outcomes following phacoemulsification using hydrophilic and hydrophobic foldable intraocular lenses in 220 eyes. The study population

predominantly belonged to the sixth and seventh decades, with most patients in the 56 - 65 years age group, which is consistent with the epidemiological pattern of senile cataract as reported by Zhao., *et al.*, Wu., *et al.* and Donachie., *et al.* A slight female predominance (56.4%) was observed, in agreement with previous studies demonstrating higher cataract prevalence among females. Baseline comparability between groups in terms of age, sex, laterality, and preoperative visual acuity ($p > 0.05$) confirms the validity of intergroup comparisons [16-18].

Uncorrected visual acuity (UCVA) showed significant improvement in both groups from the early postoperative period, with progressive gains up to 6 months. At final follow-up, 63.0% of hydrophilic and 60.8% of hydrophobic IOL eyes achieved 6/6-6/6p vision, with no statistically significant difference at any time point ($p > 0.05$). These findings are consistent with previous studies by

Brar, *et al.*, Stanojcic, *et al.* and Xing, *et al.* which reported excellent postoperative UCVA with no significant difference between IOL materials [19-21].

Best corrected visual acuity (BCVA) improved markedly in both groups, with 83.0% (hydrophilic) and 82.5% (hydrophobic) achieving 6/6-6/6p vision at 6 months. No statistically significant intergroup difference was observed ($p > 0.05$), which aligns with findings reported by Naderi, *et al.*, Bellucci, *et al.* and meta-analyses by Wu, *et al.* and Zhao, *et al.* all demonstrating comparable BCVA outcomes between hydrophilic and hydrophobic IOLs [16,22-24].

Best corrected near visual acuity (BCNVA) also improved significantly, with more than 85% of eyes achieving N6 vision at 6 months in both groups. Although early postoperative differences were noted, these were not sustained, and no statistically significant difference was observed at final follow-up ($p > 0.05$). This is consistent with prior studies reporting equivalent postoperative visual outcomes between IOL materials [16,18,23,24].

Refractive outcomes, assessed using spherical equivalent, showed excellent predictability and stability in both groups, with postoperative values approaching emmetropia (approximately -0.03 D at 6 months). No statistically significant difference was observed between groups at any time point ($p > 0.05$). These findings are supported by studies such as Stanojcic, *et al.* and Bellucci, *et al.* which also reported comparable refractive outcomes between hydrophilic and hydrophobic IOLs [23,25].

Intraocular pressure (IOP) remained stable within physiological limits throughout the follow-up period in both groups, with no statistically significant intergroup difference ($p > 0.05$). These findings are consistent with previous reports by Grzybowski, *et al.* and Liu, *et al.* which demonstrated stable postoperative IOP regardless of IOL material, although isolated reports of IOP spikes related to specific lenses have been described [26,27].

Subgroup analysis of different IOL brands within hydrophilic and hydrophobic categories also revealed no statistically significant differences in visual, refractive, or safety outcomes, indicating that intra-category variations did not significantly influence results.

Overall, the findings of this study demonstrate that both hydrophilic and hydrophobic foldable intraocular lenses provide comparable outcomes in terms of UCVA, BCVA, BCNVA, refractive

stability, and intraocular pressure. These results suggest that the choice of IOL material does not significantly influence postoperative visual outcomes, and clinical decisions may instead be guided by factors such as cost-effectiveness, availability, and patient preference.

Our study also had certain limitations in being applied to a limited number of patients, and the duration of follow up as short at only 6 months. Long term outcomes may be different from the short term outcomes as reported in the current study.

Conclusion

Both hydrophilic and hydrophobic foldable acrylic intraocular lenses demonstrated equally satisfactory and clinically acceptable outcomes following phacoemulsification, with excellent visual rehabilitation in terms of both distance and near vision and no statistically significant differences at any follow-up interval ($p > 0.05$). Postoperative intraocular pressure remained stable and comparable between groups, indicating a similar safety profile. Refractive outcomes in both groups showed significant improvement toward near-emmetropia, with excellent predictability and stability at 6 months (approximately -0.03 D), and no significant differences either between or within IOL subtypes. Although hydrophobic IOLs are reported to reduce posterior capsule opacification, this did not translate into superior functional visual outcomes within the study period. Cost-effectiveness analysis revealed that hydrophilic IOLs (Acryfold, Hydrofold) provided optimal value with favourable outcomes at lower costs, whereas premium lenses did not offer proportional economic benefit. Overall, both IOL types are equally effective and safe, and their selection should be guided by cost, availability, and surgeon preference rather than differences in clinical outcomes.

Conflict of Interest

None.

Funding Source

None of the authors have any financial disclosure regarding materials used in study.

Ethics Statement

The study was approved by institutional Ethics Committee and Review Board.

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