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ORIGINAL ARTICLE

Assessment of Contrast Sensitivity and Wavefront Analysis After Aspheric and Spherical Intraocular Lens Implantation

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Abstract

Purpose: **To evaluate the changes in contrast sensitivity and wavefront high-order aberrations (HOA) of eyes implanted with aspheric intraocular lenses (IOL) in comparison with those with standard spherical IOLs.**

Patients and methods: **The 40 patients' eyes were included in this comparative prospective investigation. There were two sets of participants in this study, A and B, each with an equal number of eyes (20). Group A: underwent standard phacoemulsification with the implantation of an AcrySof IOL (SA60AT), a single-piece, spherical monofocal IOL. The AcrySof IQ IOL (SN60WF), an aspheric monofocal IOL, was implanted in group B using standard phacoemulsification techniques at Al Hussein University Hospital, where the study was conducted, the same surgeon operated on each case.**

Results: **At the 3-month follow-up, both groups' mean uncorrected visual acuity (UCVA) and best-corrected visual acuity considerably rose from the preoperative value. The mean postoperative uncorrected visual acuity and best-corrected visual acuity in each group were not significantly different from one another ($P > 0.05$). Total aberrations ($P = 0.020$) and HOA ($P = 0.042$) were statistically different between the groups under study, with aspheric values being lower for 3 mm pupils. Our investigation revealed a very statistically significant reduction in spherical aberrations values in the aspheric group with a 3 and 5 mm pupil. According to our research, there was no statistically significant change in photopic contrast sensitivity between the two IOLs postoperatively ($P = 0.575$).**

Conclusion: **As comparison to spherical IOLs, aspheric IOLs greatly reduced HOA, notably at 5 mm pupil diameter, and significantly reduced spherical aberration at both pupil sizes.**

Keywords: Aspheric intraocular lens, Contrast sensitivity, Spherical aberrations

1. Introduction

The most advanced optical device is the human eye, although it does not always operate as well as other optical devices.[1]

The capacity of the human eye to distinguish between an object's sharpness and features is known as its visual quality. High-order aberration (HOA) is one of the key elements that influences how well the human eye sees. As living standards rise, there is an increased need for high-quality images.[2]

Implanting an intraocular lens (IOL) during cataract surgery is a reliable and efficient procedure. The purpose of cataract surgery is to enhance eyesight quality as well as visual acuity.[3]

Patients complain of bothersome visual obscuration caused by HOAs, which prompted the development of new technologies that were crucial in influencing this change in IOL technology. Spherical IOLs were first favored during cataract surgery, but as knowledge of the spherical IOL's potential to alter visual quality postoperatively increased, the aspheric IOL was developed.[4]

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The cornea has an average spherical aberration (SA) of +0.27 m. SA for spherical IOLs is also positive. Any improvement in quality can compromise the retinal image. Aspheric IOLs have stretched aspheric surfaces that induce zero or negative SA values, compensate for corneal positive SA, reduce postoperative ocular SA.[5]

Visual acuity is measured by a chart with black targets on a high-contrast white background. However, even if high visual acuity achieved, visual quality may be affected by decreased contrast sensitivity (CS), color vision, and glare. A common cause of decreased CS is lens or corneal opacification.[6]

When measuring visual acuity, patients are presented with individual high-contrast stimuli, usually letters, numbers, or geometric symbols. CS, however, can detect impairments that are not visible through visual acuity alone.[7]

This work aimed to evaluate changes in CS and higher-order wavefront aberrations in eyes implanted with aspheric IOLs compared with eyes with standard spherical IOLs.

2. Patients and methods

This comparative prospective study comprised the eyes of 40 patients. Participants in this research were divided into two groups, A and B, with 20 eyes in each. Group A: underwent conventional phacoemulsification with the implantation of a spherical monofocal IOL, AcrySof IOL (SA60AT), a single piece. Group B: underwent conventional phacoemulsification with the implantation of an aspheric monofocal IOL, the AcrySofIQ IOL (SN60WF), a single piece. The study was performed at Al Hussein University Hospital, and all cases were operated by the same surgeon.

2.1. Statistical analysis

Data were collected, revised, coded, and entered to the Statistical Package for Social Science (IBM, SPSS Inc.), version 23. The quantitative data were presented as mean, SDs, and ranges when parametric and median, interquartile range when data found nonparametric. Also qualitative variables were presented as number and percentages. The comparison between groups regarding qualitative data was done using χ^2 test and/or Fisher exact test when the expected count in any cell was found less than 5. The comparison between two independent groups with quantitative data and parametric distribution was done by using independent *t*-test while with nonparametric distribution were done using Mann–Whitney test. The comparison between two paired groups regarding quantitative data and parametric distribution was done by using paired *t*-test while with nonparametric distribution was done using Wilcoxon rank test.

2.1.1. Inclusion criteria

Clear cornea, normal intraocular pressure, corneal astigmatism not more than 2 D and age between 40 and 70 years.

2.1.2. Exclusion criteria

Mature cataract, patients with corneal opacification, eyes with previous surgery, high myopia, glaucoma, diabetes mellitus, surgical complications, IOL tilt or decentration, and posterior capsule opacification.

2.2. Preoperative evaluation

All patients underwent the following examinations:

Slit-lamp examination, uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), intraocular pressure, fundus examination, IOL calculation using IOLMaster 500 (Carl Zeiss Meditec Inc.), the Peli–Robson chart was used for CS measurement and ocular aberrations by the SCHWIND ocular wavefront analyzer.

Phacoemulsification was performed for all patients with spherical IOL implantation in group A (AcrySof IOL model SA60AT, single piece) and aspheric IOL implantation in group B (AcrySof IQ IOL model SN60WF, single piece). The phacoemulsification machine used was an Infiniti (Alcon, Fort Worth, Texas, USA).

The surgical steps are similar in all patients, and they all underwent the same postoperative treatment.

Postoperative follow-up after 3 months: all patients underwent a complete ocular examination in addition to measures of CS under photopic conditions and ocular aberrations.

2.2.1. Statement on ethics approval and informed consent from participants

The investigators presented themselves to each participant in the study, explanation of the study, and then asked for their participation. All selected participants were fully informed about the purpose and expected benefits of the research. All ethical considerations are taken into account throughout the work process. Permissions were obtained from all participants, and the confidentiality of the information was ensured. Furthermore, it was formalized with the approval of the Institutional Review Board

and the Ethics Committee of the Faculty of Medicine.

3. Results

Forty eyes of 40 patients were included in the study; an AcrySof spherical IOL (SA60AT) in 20 eyes and an AcrySof IQ IOL (SN60WF) was implanted in 20 eyes (Table 1).

As shown in Table 1, 24 (60.0 %) patients were men, and 16 (40.0 %) were women. The mean age of the patients was 56 ± 9 (range, 47–65 years). There was no statistically significant difference in the demographic data between the groups under study.

The preoperative mean UCVA, BCVA, total aberrations, SA, and CS were similar in both groups ($P > 0.05$). In a 5 mm pupil, preoperative HOA values revealed that the aspheric group's values (0.53 ± 0.12) were greater than the spherical group's (0.46 ± 0.08), which was statistically significant ($P = 0.027$) (Table 2).

The mean logMAR preoperative UCVA in spherical group was 0.89 ± 0.11 and in aspheric group was 0.86 ± 0.15 (20/144). The mean logMAR preoperative BCVA in spherical group was 0.44 ± 0.08 (20/55) and in aspheric group 0.42 ± 0.11 (20/52). The mean total aberrations with a 3 mm pupil was 0.80 ± 0.30 in the spherical group and 0.91 ± 0.50 in the aspheric group and with a 5 mm pupil diameter, 0.81 ± 0.31 and 0.95 ± 0.38, respectively. Preoperative HOAs for 3 mm pupil was 0.43 ± 0.08 and 0.46 ± 0.26 in spherical and aspheric group, respectively, and for 5 mm pupil preoperative HOA showed that values in aspheric group (0.53 ± 0.12) and the spherical group (0.46 ± 0.08). SA for 3 mm pupil was 0.28 ± 0.05, 0.28 ± 0.05 in spherical and aspheric group, respectively, and for 5 mm pupil was 0.29 ± 0.05, 0.29 ± 0.06 in spherical and aspheric group, respectively. Preoperatively, CS was 0.91 ± 0.12 and 0.89 ± 0.13 in spherical and aspheric group, respectively.

There was no significant difference between the two groups' mean postoperative UCVA, BCVA, and CS ($P > 0.05$). Total aberrations ($P = 0.020$) and HOA ($P = 0.042$) were statistically different across the examined groups, with lower values in the aspheric group for 3 mm. For 3 and 5 mm pupils, the SA values indicated a very statistically significant decline in the aspheric group. As comparison to the spherical IOL group with both pupil diameters, the aspheric IOL group had statistically significantly lower SA (Table 3).

The mean logMAR postoperative UCVA in spherical group was 0.02 ± 0.03 (20/21) and in aspheric group was 0.02 ± 0.03 (20/21), the mean logMAR postoperative BCVA in spherical group was 0.00 ± 0.03 (20/20) and in aspheric group was −0.01 ± 0.03 (20/19). The mean total aberration with a 3 mm pupil was 0.77 ± 0.69 in the spherical group and 0.71 ± 0.17 in the aspheric group and with a 5 mm pupil diameter, 0.75 ± 0.66 and 0.72 ± 0.29, respectively. The mean HOAs with a 3 mm pupil was 0.40 ± 0.11 in the spherical group and 0.33 ± 0.09 in the aspheric group and with a 5 mm pupil, 0.43 ± 0.18 and 0.34 ± 0.08, respectively. The mean SA with a 3 mm pupil was 0.18 ± 0.05 in the spherical group and 0.04 ± 0.02 in the aspheric group and with a 5 mm pupil, 0.19 ± 0.07 and 0.05 ± 0.02, respectively. Postoperatively, CS was 1.61 ± 0.15 and 1.64 ± 0.13 in spherical and aspheric group, respectively.

The postoperative mean UCVA and BCVA improvements were clearly seen in Table 4 ($P = 0.001$). Total aberrations and HOA did not differ statistically significantly ($P = 0.279$ and 0.225, respectively). Postoperatively, SA for 3 and 5 mm pupils ($P = 0.01$) as well as CS (P=0.01) both showed very statistically significant improvement (Table 4).

The mean logMAR preoperative UCVA was 0.89 ± 0.11 (20/155) and BCVA was 0.44 ± 0.08 (20/55), the mean logMAR postoperative UCVA was 0.02 ± 0.03 (20/21) and BCVA was 0.00 ± 0.03 (20/20). The mean total aberration with a 3 mm pupil was 0.80 ± 0.30 preoperatively and 0.77 ± 0.69 postoperatively and with a 5 mm pupil diameter, 0.81 ± 0.31and 0.75 ± 0.66, respectively. The mean

Table 1. Comparison between the study groups regarding demographic data.

	Spherical	Aspheric	*P* value	Significance
	20	20		
Age				
Mean ± SD	56.60 ± 6.54	56.80 ± 7.59	0.929	NS
Range	45–69	43–69		
Sex [*n* (%)]				
Female	7 (35.0)	9 (45.0)	0.519	NS
Male	13 (65.0)	11 (55.0)		
Eye				
OD	8 (40.0)	10 (50.0)	0.525	NS
OS	12 (60.0)	10 (50.0)		

Table 2. Comparison between preoperative results in both groups.

Preoperative	Spherical IOL	Aspheric IOL	*P* value	Significance
	$N = 20$	$N = 20$		
UCVA	0.89 ± 0.11	0.86 ± 0.15	0.962	NS
	0.78–1	0.48–1		
BCVA	0.44 ± 0.08	0.42 ± 0.11	0.635	NS
	0.18–0.48	0.18–0.48		
3 mm				
Total	0.80 ± 0.30	0.91 ± 0.50	0.871	NS
	0.34–1.3	0.45–2.05		
HOA	0.43 ± 0.08	0.46 ± 0.26	0.615	NS
	0.3–0.57	0.21–1.17		
SA	0.28 ± 0.05	0.28 ± 0.05	0.713	NS
	0.19–0.38	0.21–0.38		
5 mm				
Total	0.81 ± 0.31	0.95 ± 0.38	0.371	NS
	0.39–1.3	0.55–1.97		
HOA	0.46 ± 0.08	0.53 ± 0.12	0.027	S
	0.32–0.6	0.33–0.75		
SA	0.29 ± 0.05	0.29 ± 0.06	0.892	NS
	0.21–0.38	0.2–0.38		
CS	0.91 ± 0.12	0.89 ± 0.13	0.531	NS
	0.75–1	0.75–1		

BCVA, best-corrected visual acuity; CS, contrast sensitivity; HOA, high-order aberration; SA, spherical aberration; UCVA, uncorrected visual acuity.

Table 3. Comparison between postoperative results in both groups.

Postoperative	Spherical IOL	Aspheric IOL	*P* value	Significance
	$N = 20$	$N = 20$		
UCVA	0.02 ± 0.03	0.02 ± 0.03	0.739	NS
	0–0.07	0–0.07		
BCVA	0.00 ± 0.03	−0.01 ± 0.03	0.485	NS
	−0.08 to 0.07	−0.08 to 0.07		
3 mm				
Total	0.77 ± 0.69	0.71 ± 0.17	0.020	S
	0.31–2.58	0.56–1.3		
HOA	0.40 ± 0.11	0.33 ± 0.09	0.042	S
	0.29–0.65	0.180–0.470		
SA	0.18 ± 0.05	0.04 ± 0.02	0.000	HS
	0.08–0.28	0.010–0.090		
5 mm				
Total	0.75 ± 0.66	0.72 ± 0.29	0.136	NS
	0.31–2.53	0.3–1.33		
HOA	0.43 ± 0.18	0.34 ± 0.08	0.053	NS
	0.26–0.92	0.200–0.510		
SA	0.19 ± 0.07	0.05 ± 0.02	0.000	HS
	0.13–0.34	0.02–0.08		
CS	1.61 ± 0.15	1.64 ± 0.13	0.575	NS
	1.25–1.75	1.500–1.750		

BCVA, best-corrected visual acuity; CS, contrast sensitivity; HOA, high-order aberration; SA, spherical aberration; UCVA, uncorrected visual acuity.

HOAs with a 3 mm pupil was 0.43 ± 0.08 preoperatively and 0.40 ± 0.11 postoperatively and with a 5 mm pupil, 0.46 ± 0.08 and 0.75 ± 0.66, respectively. The mean SA with a 3 mm pupil was 0.28 ± 0.05 preoperatively and 0.18 ± 0.05 postoperatively and with a 5 mm pupil, 0.29 ± 0.05and 0.19 ± 0.07, respectively. CS was 0.91 ± 0.12 preoperatively and 1.61 ± 0.15 postoperatively.

The mean UCVA and BCVA postoperatively exhibited significantly significant improvements ($P = 0.001$). There was an improvement in SA and a statistically significant improvement in HOA

Table 4. Comparison between preoperative and postoperative results in spherical group.

Spherical IOL	Preoperative	Postoperative	*P* value	Significance
UCVA	0.89 ± 0.11 0.78–1	0.02 ± 0.03 0–0.07	0.001	HS
BCVA	0.44 ± 0.08 0.18–0.48	0.00 ± 0.03 −0.08–0.07	0.001	HS
3 mm				
Total	0.80 ± 0.30 0.34–1.3	0.77 ± 0.69 0.31–2.58	0.279	NS
HOA	0.43 ± 0.08 0.3–0.57	0.40 ± 0.11 0.29–0.65	0.225	NS
SA	0.28 ± 0.05 0.19–0.38	0.18 ± 0.05 0.08–0.28	0.000	HS
5 mm				
Total	0.81 ± 0.31 0.39–1.3	0.75 ± 0.66 0.31–2.53	0.073	NS
HOA	0.46 ± 0.08 0.32–0.6	0.43 ± 0.18 0.26–0.92	0.448	NS
SA	0.29 ± 0.05 0.21–0.38	0.19 ± 0.07 0.13–0.34	0.000	HS
CS	0.91 ± 0.12 0.75–1	1.61 ± 0.15 1.25–1.75	0.000	HS

BCVA, best-corrected visual acuity; CS, contrast sensitivity; HOA, high-order aberration; IOL, intraocular lens; SA, spherical aberration; UCVA, uncorrected visual acuity.

($P = 0.020$) for a 3 mm pupil. With a 5 mm pupil, there was a very statistically significant increase in HOA, SA, and CS postoperatively ($P = 0.01$) as well as a statistically significant improvement in total aberrations ($P = 0.043$) (Table 5).

The mean logMAR preoperative UCVA was 0.86 ± 0.15 (20/144) and BCVA was 0.42 ± 0.11 (20/52), the mean logMAR postoperative UCVA was 0.02 ± 0.03 (20/21) and BCVA was −0.01 ± 0.03 (20/19). The mean total aberration with a 3 mm pupil was 0.91 ± 0.50 preoperatively and 0.71 ± 0.17 postoperatively and with a 5 mm pupil diameter, 0.95 ± 0.38 and 0.72 ± 0.29, respectively. The mean HOAs with a 3 mm pupil was 0.46 ± 0.26 preoperatively and 0.33 ± 0.09 postoperatively and with a 5 mm pupil, 0.53 ± 0.12 and 0.34 ± 0.08, respectively. The mean SA with a 3 mm pupil was 0.28 ± 0.05 preoperatively and 0.04 ± 0.02 postoperatively and

Table 5. Comparison between preoperative and postoperative in aspheric group.

Aspheric IOL	Preoperative	Postoperative	*P* value	Significance
UCVA	0.86 ± 0.15 0.48–1	0.02 ± 0.03 0–0.07	0.001	HS
BCVA	0.42 ± 0.11 0.18–0.48	−0.01 ± 0.03 −0.08 to 0.07	0.001	HS
3 mm				
Total	0.91 ± 0.50 0.45–2.05	0.71 ± 0.17 0.56–1.3	0.167	NS
HOA	0.46 ± 0.26 0.21–1.17	0.33 ± 0.09 0.180–0.470	0.020	S
SA	0.28 ± 0.05 0.21–0.38	0.04 ± 0.02 0.010–0.090	0.000	HS
5 mm				
Total	0.95 ± 0.38 0.55–1.97	0.72 ± 0.29 0.3–1.33	0.043	S
HOA	0.53 ± 0.12 0.33–0.75	0.34 ± 0.08 0.200–0.510	0.000	HS
SA	0.29 ± 0.06 0.2–0.38	0.05 ± 0.02 0.02–0.08	0.000	HS
CS	0.89 ± 0.13 0.75–1	1.64 ± 0.13 1.500–1.750	0.000	HS

BCVA, best-corrected visual acuity; CS, contrast sensitivity; HOA, high-order aberration; IOL, intraocular lens; SA, spherical aberration; UCVA, uncorrected visual acuity.

Table 6. Comparison between the two studied groups regarding difference between preoperative and postoperative.

Difference	Spherical IOL	Aspheric IOL		
	$N = 20$	$N = 20$	P value	Significance
UCVA	−0.86 ± 0.12	−0.84 ± 0.14	0.840	NS
	−1 to −0.71	−1 to −0.48		
BCVA	−0.45 ± 0.09	−0.43 ± 0.12	0.818	NS
	−0.56 to −0.18	−0.56 to −0.18		
3 mm				
Total	−0.03 ± 0.63	−0.20 ± 0.49	0.860	NS
	−0.88 to 1.38	−1.15 to 0.71		
HOA	−0.03 ± 0.12	−0.13 ± 0.23	0.278	NS
	−0.23 to 0.17	−0.87 to 0		
SA	−0.10 ± 0.05	−0.24 ± 0.05	0.000	HS
	−0.18 to 0	−0.34 to −0.17		
5 mm				
Total	−0.06 ± 0.58	−0.23 ± 0.45	0.766	NS
	−0.89 to 1.23	−1.67 to 0.33		
HOA	−0.03 ± 0.18	−0.19 ± 0.13	0.004	HS
	−0.33 to 0.46	−0.4 to −0.01		
SA	−0.10 ± 0.07	−0.24 ± 0.06	0.000	HS
	−0.22 to 0.03	−0.33 to −0.15		
CS	0.70 ± 0.19	0.75 ± 0.20	0.484	NS
	0.25–1	0.5–1		

BCVA, best-corrected visual acuity; CS, contrast sensitivity; HOA, high-order aberration; IOL, intraocular lens; SA, spherical aberration; UCVA, uncorrected visual acuity.

with a 5 mm pupil, 0.29 ± 0.06 and 0.05 ± 0.02, respectively. CS was 0.89 ± 0.13 preoperatively and 1.64 ± 0.13 postoperatively.

In comparing between the two IOLs groups, there was no statistically significant difference in UCVA, BCVA, total aberrations, or CS. The aspheric IOL caused less HOA than the spherical IOL, yet there was a highly statistically significant difference in HOA in a 5 mm pupil ($P = 0.004$). Moreover, the spherical group with both pupil diameters had statistically substantially more SA than the aspheric group ($P < 0.01$) (Table 6).

The mean logMAR postoperative UCVA in spherical group was −0.86 ± 0.12 and in aspheric group was −0.84 ± 0.14, the mean logMAR postoperative BCVA in spherical group was −0.45 ± 0.09 and in aspheric group was −0.43 ± 0.12. The mean total aberration with a 3 mm pupil was −0.03 ± 0.63 in the spherical group and −0.20 ± 0.49 in the aspheric group and with a 5 mm pupil diameter, −0.06 ± 0.58 and −0.23 ± 0.45, respectively. The mean SA with a 3 mm pupil was −0.10 ± 0.05 in the spherical group and −0.24 ± 0.05 in the aspheric group and with a 5 mm pupil was −0.10 ± 0 and

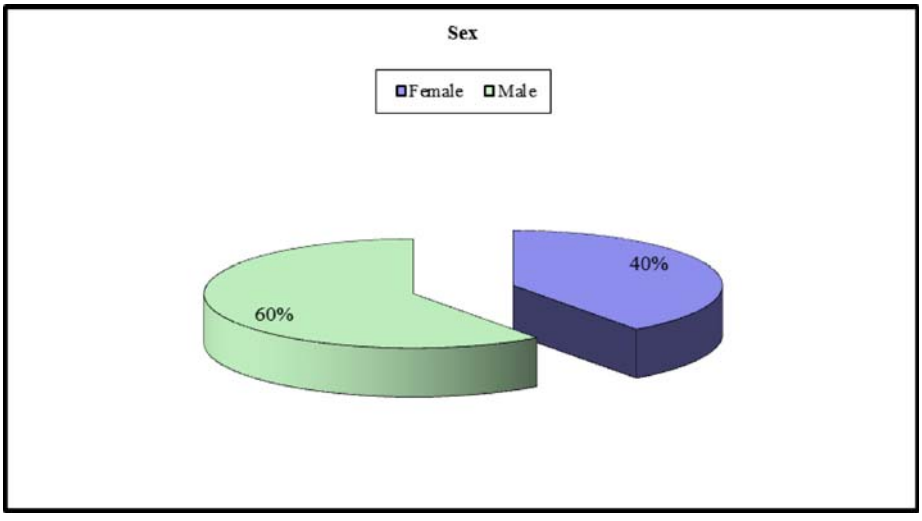

Fig. 1. Demographic data.

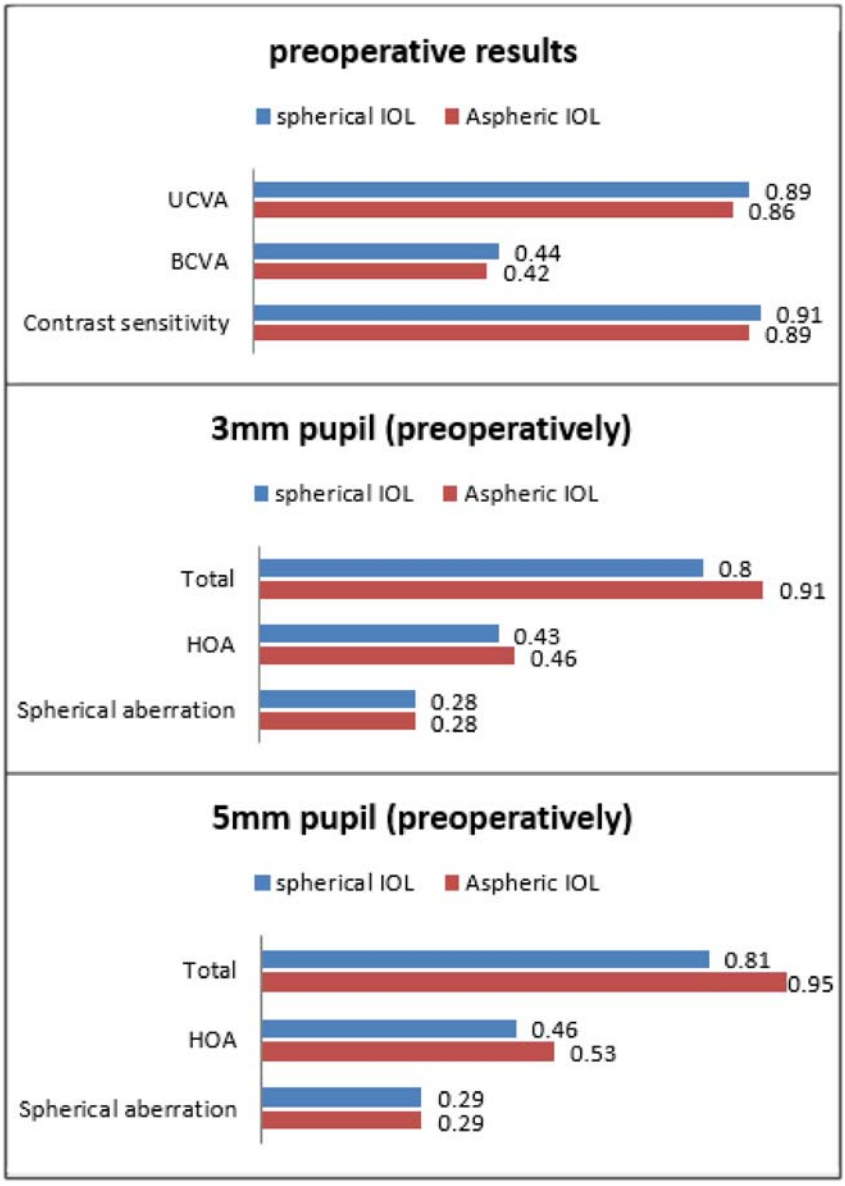

Fig. 2. Comparison between preoperative results in both groups.

−0.24 ± 0.06, respectively. CS was 0.70 ± 0.19 and 0.75 ± 0.20 in spherical and aspheric group, respectively.

As shown in Fig. 1, 40 eyes of 40 patients were included in the study, 24 (60.0 %) patients were men, and 16 (40.0 %) were women. The mean age of the patients was 56 ± 9 years (range, 47–65 years).

As shown in Fig. 2, the mean logMAR preoperative UCVA in spherical group was 0.89 ± 0.11 and in aspheric group was 0.86 ± 0.15. The mean logMAR preoperative BCVA in spherical group was 0.44 ± 0.08 (20/55) and in aspheric group 0.42 ± 0.11.

As shown in Fig. 3, the mean logMAR postoperative UCVA in spherical group was 0.02 ± 0.03 (20/21) and in aspheric group was 0.02 ± 0.03 (20/21), the mean logMAR postoperative BCVA in spherical group was 0.00 ± 0.03 (20/20) and in aspheric group was −0.01 ± 0.03 (20/19). There was no significant difference in the mean postoperative UCVA and BCVA in either group ($P > 0.05$).

As shown in Fig. 4, the Mean logMAR preoperative UCVA was 0.89 ± 0.11 (20/155) and BCVA was 0.44 ± 0.08 (20/55), the mean logMAR postoperative UCVA was 0.02 ± 0.03 (20/21) and BCVA was 0.00 ± 0.03 (20/20); which showed highly significant improvement of mean UCVA and BCVA postoperatively ($P = 0.001$).

As shown in Fig. 5, the Mean logMAR preoperative UCVA was 0.86 ± 0.15 (20/144) and BCVA was 0.42 ± 0.11 (20/52), the mean logMAR postoperative

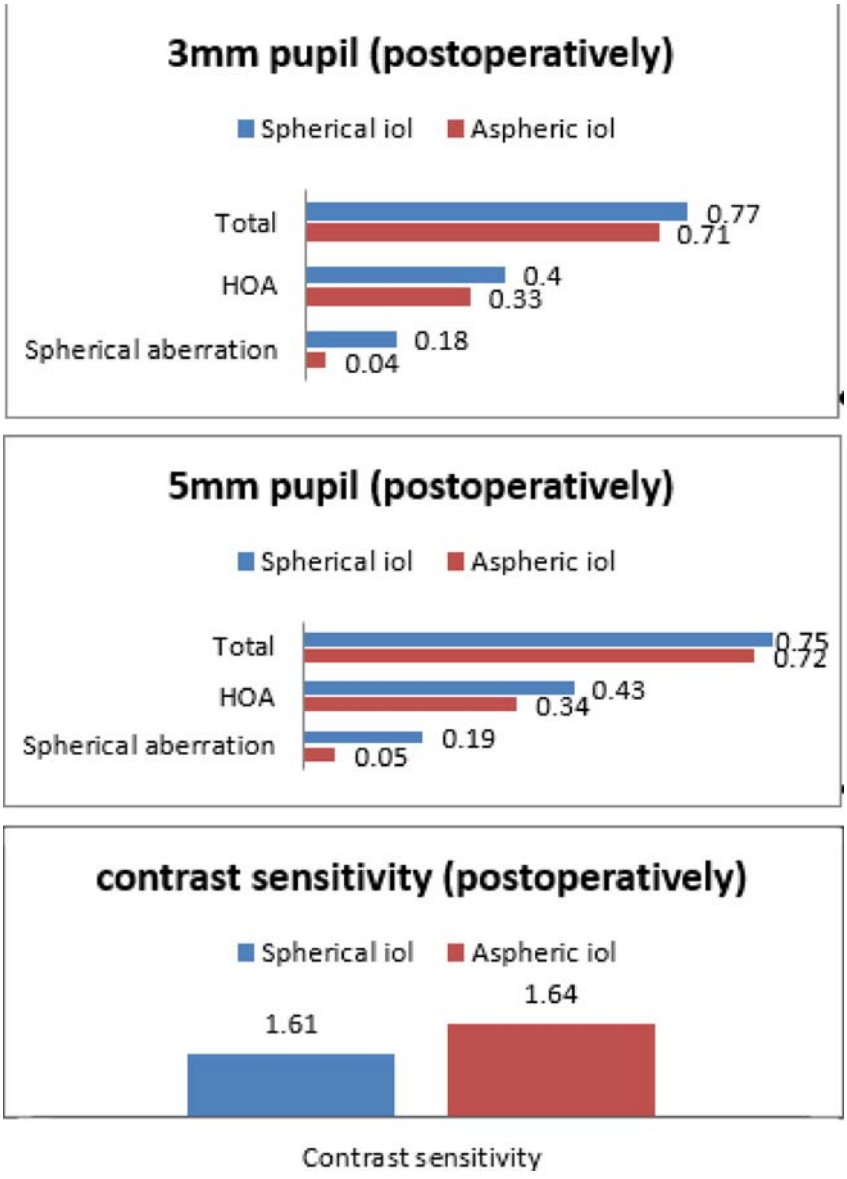

Fig. 3. Comparison between postoperative results in both groups.

UCVA was 0.02 ± 0.03 (20/21) and BCVA was −0.01 ± 0.03 (20/19) which showed highly significant improvement of the mean UCVA and BCVA postoperatively ($P = 0.001$).

As shown in Fig. 6, there was highly statistically significant difference in HOA in 5 mm pupil ($P = 0.004$); the aspheric IOL induced less HOA than the spherical IOL. The aspheric group also had statistically significantly less SA than spherical group with both pupil diameters ($P < 0.01$).

4. Discussion

Emphasize on the quality of life today; thanks to advancements in IOL and cataract surgery, the visual outcome is assessed not only in terms of VA but also in terms of vision quality. Wavefront aberration and CS are important aspects of visual quality.[8]

In our study, both groups' 3-month follow-up mean UCVA and BCVA considerably rose from the preoperative value. The mean logMAR postoperative UCVA in the spherical group was 0.02 ± 0.03 (20/21) and the mean logMAR postoperative BCVA in the spherical group was 0.00 ± 0.03 (20/20) while the mean logMAR postoperative BCVA in the aspheric group was −0.01 ± 0.03 (20/19). There was no discernible difference between either group's mean postoperative UCVA and BCVA ($P > 0.05$).

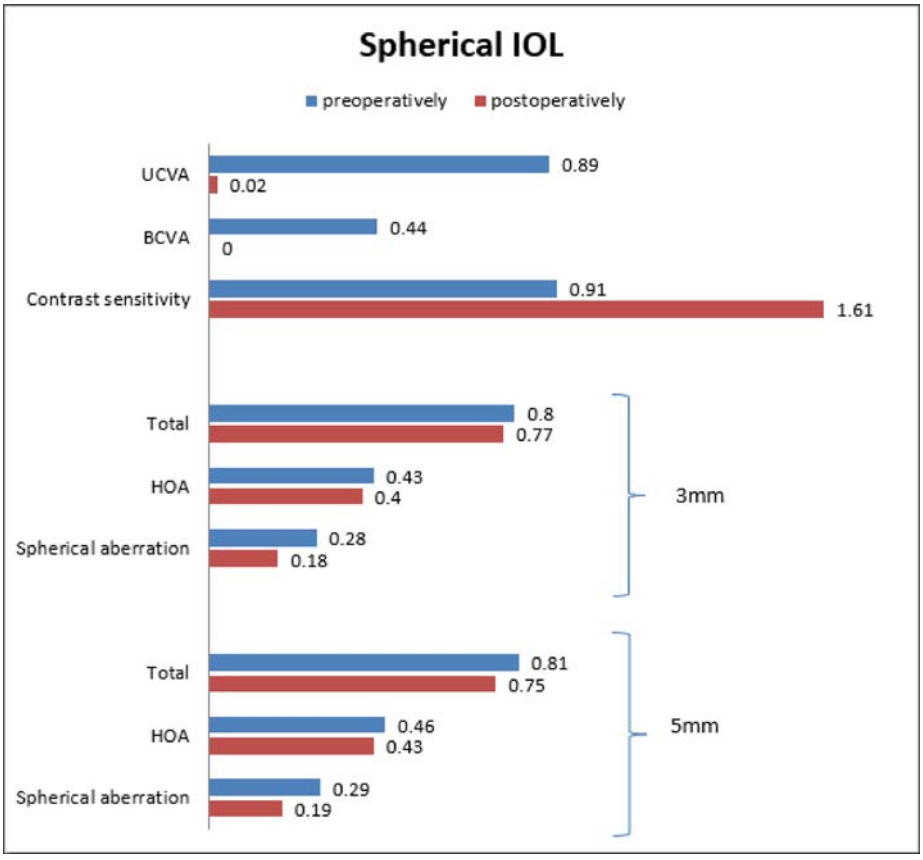

Fig. 4. Comparison between preoperative and postoperative in spherical group.

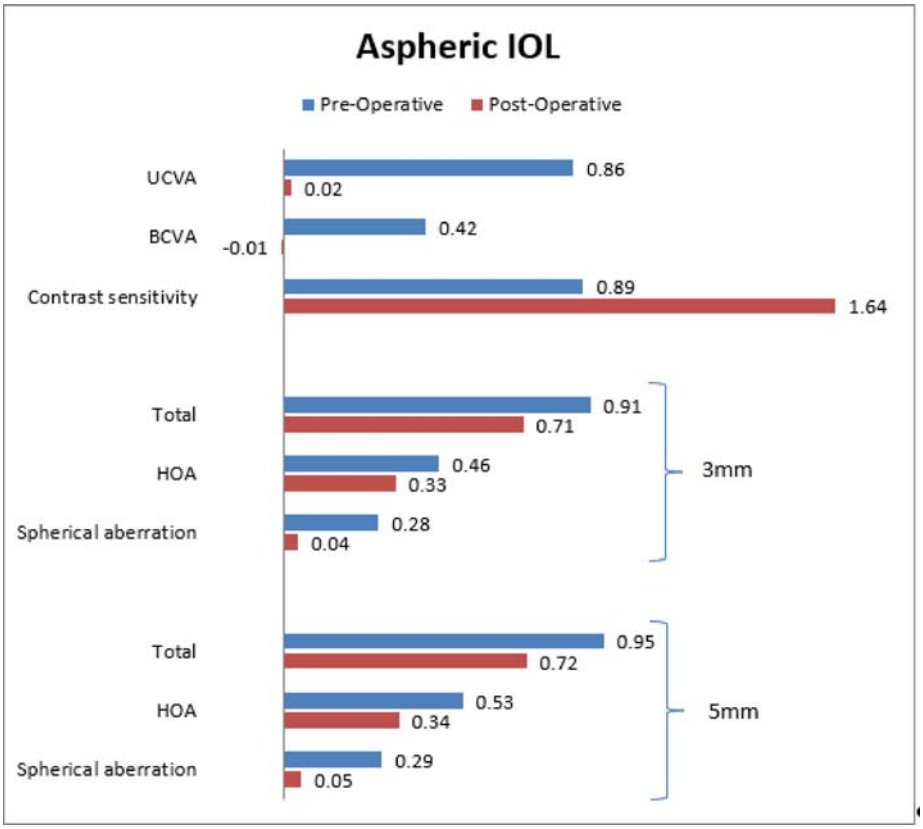

Fig. 5. Comparison between preoperative and postoperative in aspheric group.

This finding is consistent with Chen *et al.*,[3] Santiago et al.,[8] Liao et al.[9] who found no differences in BCVA between the spherical IOLs and aspherical IOLs before and after surgery.

In contrast to our work, Yagci et al.[10] found that Rayner 920H aspheric IOL group eyes had a mean BCVA that was higher than Rayner 620H spherical IOL group eyes ($P = 0.002$).

According to our research, the mean total aberration with a 3 mm pupil was 0.77 ± 0.69 in the spherical group, 0.71 ± 0.17 in the aspheric group, and 0.75 ± 0.66 and 0.72 ± 0.29, respectively, with a 5 mm pupil diameter. The mean HOAs were 0.40 ± 0.11 in the spherical group, 0.33 ± 0.09 in the aspheric group, and 0.43 ± 0.18 and 0.34 ± 0.08, respectively, with a 5 mm pupil. Total aberrations ($P = 0.020$) and HOA ($P = 0.042$) differed statistically significantly across the examined groups, with lower values in the aspheric group for 3 mm pupils. According to Liao et al.[9] findings, which are identical to our own, there was a statistically significant difference in total HOAs between the IOLs groups, with lower values in the aspheric group ($P = 0.03$).

Also supporting our findings, Santiago et al.[8] demonstrated that, for pupils with 5.0 and 6.0 m pupil diameters, the aspheric IOL group (Akreos AO) had statistically significantly lower mean HOA values than Akreos Fit. Moreover, AcrySofIQ IOL showed lower overall aberrations values as well as lower HOA values than AcrySof Natural, according to Rocha et al.[11] Also, our research supported Jirásková et al.,[12] who found that the AcrySofIQ IOL displayed less HOA in pupils with a diameter of 6 mm.

According to our research, the aspheric group with 3 and 5 mm pupils had much lower SA values than the other groups. As comparison to the spherical IOL group with both pupil diameters, the aspheric IOL group had statistically significantly lower SA ($P < 0.01$). The mean SA for the spherical group with a 3 mm pupil was 0.18 ± 0.05, for the aspheric group it was 0.04 ± 0.02, and for the 5 mm pupil it was 0.19 ± 0.07 and 0.05 ± 0.02, respectively. Our research supported prior findings that aspherical IOLs significantly reduce SA. According to Santiago et al.,[8] the Akreos AO IOL significantly had lower SA values than the Akreos Fit IOL ($P = 0.002$

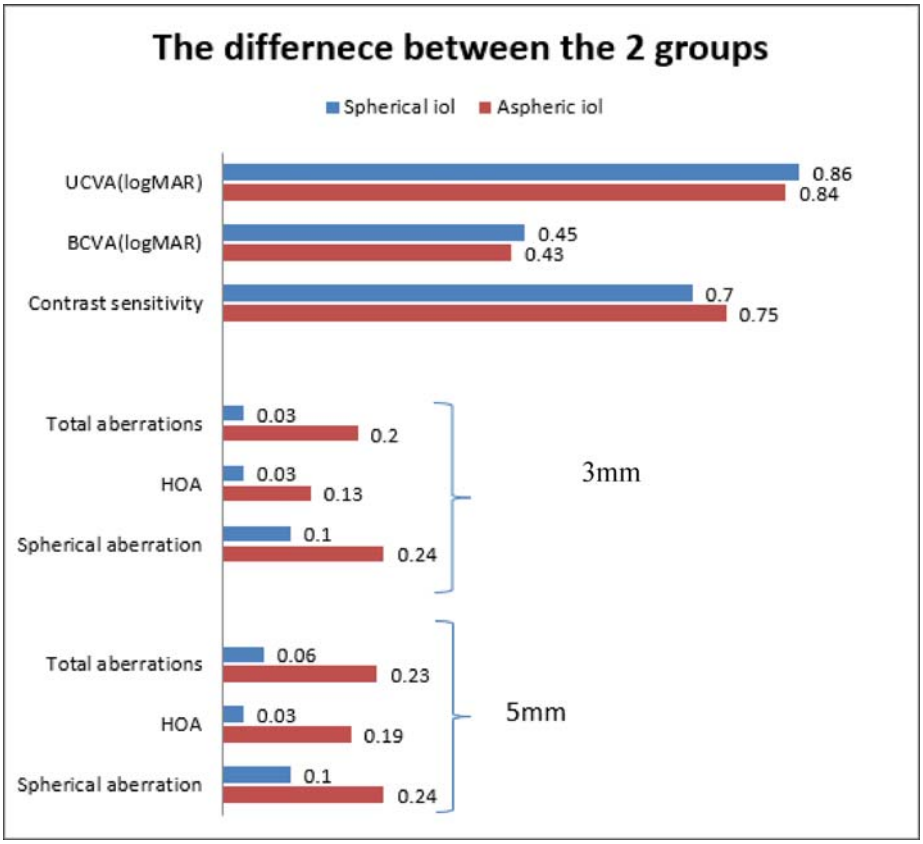

Fig. 6. Comparison between two studied groups regarding difference between preoperative and postoperative.

and 0.001, respectively). Rocha et al.[11] demonstrated that the AcrySofIQ IOL had reduced SA when compared with the spherical IOLs. This is in line with the findings of our investigation. AcrySofIQ IOL had significantly reduced SA, according to wavefront analysis.

Moreover, Yagci et al.[10] found that the aspheric IOL group had considerably lower SA values ($P = 0.003$) and total HOAs ($P = 0.002$) than the spherical IOL group. According to Liao et al.,[9] SA with 4.0 and 6.0 mm pupils exhibited statistically significant differences ($P = 0.001$). SA were significantly lower using the aspheric IOL, according to Crnej et al.[13] ($P = 0.01$).

Jirásková et al.[12] showed that the AcrySof IQ IOL achieved a statistically significantly lower SA compared with his AcrySof Natural IOL with spherical shape.

In terms of CS, our research revealed that there was no postoperatively statistically significant difference in photopic CS between the two IOL groups ($P = 0.575$). Jirásková et al.[12] demonstrated that there were no statistically significant differences in CS between the AcrySof SN60WF and AcrySof SN60AT groups, which is consistent to our findings. Rocha et al.[11] findings that there were no statistically significant variations in CS between the three groups concur with our findings. The average CS was 1.61 ± 0.09 (IQ), 1.60 ± 0.10 (natural), and 1.61 ± 0.08 (all other) (Sensar). Yagci et al.[10] demonstrated that CS was noticeably higher with the aspheric IOL, which is consistent with our results. Santiago and colleagues demonstrated that, in photopic conditions, the Akreos AO IOL provided statistically superior CS than the Akreos Fit IOL ($P = 0.028$), which is also consistent with our findings. The Akreos AO IOL demonstrated under mesopic circumstances. The Pelli-Robson test yielded mean CS scores of 1.57 ± 0.03 for the Akreos AO group and 1.56 ± 0.03 for the Akreos Fit group ($P = 0.041$).[8]

4.1. Conclusion

As comparison to spherical IOLs, aspheric IOLs greatly reduced HOA, notably at 5 mm pupil diameter, and significantly reduced SA at both pupil sizes.

4.1.1. The limitations of the study

The study suffers from the limitation of a relatively small sample size. In addition, a longer follow-up is required to compare the difference in visual quality and CS in different types of IOLs.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Du W, Lou W, Wu Q. Personalized aspheric intraocular lens implantation based on corneal spherical aberration: a review. *Int J Ophthalmol*. 2019;12:1788.
2. Chen T, Yu F, Lin H, Zhao Y, Chang P. Objective and subjective visual quality after implantation of all optic zone diffractive multifocal intraocular lenses: a prospective, case-control observational study. *Br J Ophthalmol*. 2016;100:1530–1535.
3. Chen Y, Wang X, Zhou CD, Wu Q. Evaluation of visual quality of spherical and aspherical intraocular lenses by optical quality analysis system. *Int J Ophthalmol*. 2017;10:914.
4. Yiğit U, Çavuşoğlu E, Onur İU, Kaya FS. Clinical outcomes following implantation of a new aspheric monofocal intraocular lens. *J Acad Res Med*. 2019;9:3.
5. Tan QQ, Lin J, Tian J, Liao X, Lan CJ. Objective optical quality in eyes with customized selection of aspheric intraocular lens implantation. *BMC Ophthalmol*. 2019;19:1–7.
6. Augustin VA, Weller JM, Kruse FE, Tourtas T. Influence of corneal guttae and nuclear cataract on contrast sensitivity. *Br J Ophthalmol*. 2021;105:1365–1370.
7. Nixon DR, Flinn NA. Evaluation of contrast sensitivity and other visual function outcomes in neovascular age-related macular degeneration patients after treatment switch to aflibercept from ranibizumab. *Clin Ophthalmol*. 2017;11:715–721.
8. Santiago MR, Netto MV, JrJ Barreto, Gomes BA, Mukai A. Wavefront analysis, contrast sensitivity, and depth of focus after cataract surgery with aspherical intraocular lens implantation. *Am J Ophthalmol*. 2010;149:383–389.
9. Liao X, Lin J, Tan Q, Wen B, Tian J. Evaluation of visual quality in pseudophakic eyes with different ocular spherical aberrations. *Curr Eye Res*. 2019;44:963–967.
10. Yagci R, Uzun F, Acer S, Hepsen IF. Comparison of visual quality between aspheric and spherical IOLs. *Eur J Ophthalmol*. 2014;24:688–692.
11. Rocha KM, Soriano ES, Chalita MR, et al. Wavefront analysis and contrast sensitivity of aspheric and spherical intraocular lenses: a randomized prospective study. *Am J Ophthalmol*. 2006;142:750–756.
12. Jirásková N, Urminský J, Lorencova V, Feuermannova A, Stepanov A. Optical aberrations and contrast sensitivity of spherical and aspheric intraocular lenses—a prospective comparative clinical study. *J Clin Exp Ophthalmol*. 2012;3:254.
13. Crnej A, Buehl W, Greslechner R, Hirnschall N, Findl O. Effect of an aspheric intraocular lens on the ocular wave-front adjusted for pupil size and capsulorhexis size. *Acta Ophthalmol*. 2014;92:e353–e357.