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Original research

A comparative study on visual and optical performance of Akreos AO and Kontur AB IOLs after phacoemulsification cataract surgery

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Abstract

***Purpose*:** Akreos AO and Kontur AB are two commonly used intraocular lenses (IOLs) in Iran. This study was designed to evaluate the visual performance of these lenses.
***Methods*:** In a comparative interventional study, 35 patients (70 eyes) were recruited, and each IOL was implanted in one eye of the patients, randomly. Best corrected visual acuity (BCVA), contrast sensitivity, aberrometric analysis, and depth of focus were evaluated 1 month and 3 months postoperatively. A visual quality questionnaire was also filled for each eye, and the results were compared.
***Results*:** Mean age of the patients was 60.97 ± 7.00 years. BCVA was not significantly different between the two eyes, before, 1 month, and 3 months postoperatively ($p > 0.05$ for all). Photopic and mesopic contrast sensitivity was not different between the two lenses instead of photopic 18 cycles per degree, 3 months postoperatively and in mesopic 6 cycles per degree 1 month postoperatively ($p = 0.034$ and $p = 0.002$, respectively). Aberrometric factors including HoRMS, Total RMS, and Higher order without Z(4,0) were not significantly different between the two lenses ($p > 0.05$ for all), but they were slightly lower for Akreos AO. Post-operative distance-corrected visual acuity for intermediate and near vision were not different between the two groups ($p > 0.05$, respectively).
***Conclusion*:** Visual performance of Akreos AO and Kontur AB is similar. However, contrast sensitivity and aberrometric parameters are slightly better for Akreos AO IOL.
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Keywords: Akreos AO; Kontur AB; Contrast sensitivity; Aberrometry; Depth of focus

Introduction

The human cornea has positive spherical aberration because it focuses peripheral light anterior to the point of convergence for rays traced through the center.[1] With age, positive spherical aberration increases, and, accordingly, mesopic contrast sensitivity decreases. In such an eye, implantation of a traditional spherical intraocular lens (IOL) will add the positive spherical aberration, and despite the superior clarity of the IOL, it may not improve mesopic functional acuity contrast in phakic eyes.[2] To balance positive spherical aberration of the cornea, commercially available aspherical IOLs present different amounts of spherical aberration.[3]

New aspherical IOL designs such as Akreos Advanced Optic (Akreos AO; Bausch & Lomb, Inc., Rochester, New York, USA) are considered aberration-free because their anterior and posterior prolate surfaces generate, theoretically, no negative spherical aberration.[3]

In this study, we tried to compare two commonly used aspherical IOLs (Akreos AO vs Kontur AB Medicontur

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Medical Engineering LTD, Zsámbék, Hungary) for post-operative objective and subjective visual function (aberrometric and contrast sensitivity results).

In order to enhance post-operative visual function of our patients, we tried to find out the IOL which results in better postsurgical visual and optical outcomes. It is notable that we found no previous report about visual performance of Kontur AB IOL in scientific databases.

Methods

Seventy eyes of 35 patients with diagnosis of bilateral senile cataract grade III or more (according to LOCS criteria[4]) were included in this comparative interventional study after receiving ethical consent. Exclusion criteria were axial length >24.9 mm or <22.5 mm, corneal astigmatism >1.50 diopter, any history of ocular pathology including opaque or irregular cornea, dry eye, amblyopia, glaucoma, and retinal disorders. There were also postsurgical exclusion criteria including any postoperative complication, postoperative best corrected visual acuity (BCVA) less than 20/30 (0.18Log MAR), IOL tilt or decentration, and not taking part in follow up sessions. A complete preoperative examination was performed including dilated funduscopy and slit lamp evaluation, measuring of axial length by Lenstar (Haag Streit, USA), and intraocular pressure (IOP) evaluation by Goldmann applanation tonometer. Patients were randomly allocated Akreos AO (Akreos AO, Bausch & Lomb, Inc) or Kontur AB IOLs to each eye. An expert surgeon performed a standard phaco chop phacoemulsification technique. Each IOL was implanted in an interval of about one month. Table 1 shows the specification of each study lens.

Preoperatively and 1 and 3 months postoperatively, all patients were evaluated and BCVA in 4 m and 40 cm was assessed by near and distance ETDRS acuity charts.

One and 3 months postoperatively, photopic and mesopic (chart luminance: 85 cd/m^2 and 3.0 cd/m^2 respectively) contrast sensitivity was evaluated by CSV1000E chart (Vector Vision Inc., Dayton, Ohio, USA). Test distance was 2.5 m, and the results were recorded as $\log_{10}$contrast.

Aberrometric findings were recorded 1 and 3 months postoperatively. Pupils were dilated with tropicamide 1.0%, and root mean square (RMS) and spherical aberration (z4) were measured by Technolas aberrometer (Zyoptix system; Bausch & Lamb, USA) for 5 and 6 mm pupil.

Depth of focus was another factor which was compared between eyes. To measure this factor, we corrected distance refractive error and measured visual acuity (in Log MAR) for intermediate (1 m) and near (33.0 cm) distances without incorporating any addition.[3]

We also used a visual quality questionnaire which was previously used by Tester et al[5] to compare postoperative quality of vision for two lenses.

Statistical analysis

SPSS statistical software (version 18.0, SPSS, Inc, Chicago, Illinois, USA) was used for statistical analysis. Non parametric Wilcoxon paired t-test was applied for comparisons between the two groups. For all results, $p < 0.05$ was considered significant.

Results

Seventy eyes of 35 patients were enrolled in this study. The mean age of patients was 60.97 years ± 7.00 (SD) (range: 49–72 years). All patients were attended in 1 and 3 months follow up after surgery.

There was no significant difference in IOP, axial length, and keratometry between the two groups (Table 2).

Before surgery and 1 and 3 months postsurgery, mean BCVA and mean spherical equivalent of refractive error were not significantly different between the 2 groups (Table 2).

Three months postsurgically, photopic contrast sensitivity was significantly different between the 2 eyes in high spatial frequencies (18 cycles/deg) ($p = 0.034$). There was no

Table 2
Demographic data.

		Akreos AO	Kantur AB	*p*-value
IOP (mmHg)	Preoperative	17.49 ± 2.16	17.46 ± 2.15	0.956
Axial length (mm)	Preoperative	23.31 ± 0.45	23.35 ± 0.04	0.654
Keratometry (D)	Preoperative	43.39 ± 0.96	43.28 ± 1.01	0.630
	1 month post-op	43.63 ± 0.95	43.58 ± 1.06	0.836
	3months post-op	43.38 ± 1.06	43.48 ± 1.10	0.70
BCVA (LogMAR)	Preoperative	0.52 ± 0.18	0.51 ± 0.13	0.793
	1 month post-op	0.08 ± 0.07	0.08 ± 0.054	0.98
	3 months post-op	0.053 ± 0.045	0.051 ± 0.041	0.77
Spherical equivalent (D)	1 month post-op	0.07 ± 1.37	0.11 ± 1.20	0.65
	3 months post-op	−0.06 ± 1.10	0.04 ± 1.07	0.793

D: Diopters, BCVA: Best corrected visual acuity, IOP: Intraocular pressure.

Table 1
Specifications of study lenses.

Lens type	Lens material	Power range: Total diameter	Optical diameter	Haptic design	Angulation	A-constant	Optic	PCO protection
Akreos AO	Hydrophil acrylic (26.0%water content)	0.0 to +15.0: 11.0 mm +15.5 to +22.0: 10.7 mm +22.5 to +30.0: 10.5 mm	6.0 mm	4 closed loops	0°	118.0	Aberration-free, biconvex, aspheric	360° anti PCO berrier, square edge design
Kontur AB	Hydrophil acrylic (26.0%water content))	0.0 to +15.0: 11.0 mm +15.5 to +22.0: 10.7 mm +22.5 to +35.0: 10.5 mm	6.0 mm	4 closed loops	0°	118.0	Aberration-free, biconvex, aspheric	360° Special square edge

PCO: Posterior capsule opacity.

statistically significant difference between the 2 groups in other spatial frequencies ($p > 0.05$ for all). One month after surgery, in mesopic condition, mean contrast sensitivity (in 6 cycles/deg) in eyes implanted with Akreos AO was significantly better than Kontur AB ($p = 0.002$), but there was no difference in other spatial frequencies and in 3 months postsurgery ($p > 0.05$ for all).

Fig. 1(A–D) shows photopic and mesopic contrast sensitivity changes in 2 groups, 1 and 3 months postoperatively.

Aberrometric parameters (spherical aberration or Z(4,0), total RMS and HoRMS) was also compared between the two groups for 5 and 6 mm pupil. Results showed that there was no significant difference between groups for aberrometric parameters ($p > 0.05$ for all, Table 3). Also, mean undilated pupil size was not significantly different between the two groups ($p = 0.658$) (3.37 mm ± 0.64 in Akreos AO vs 3.38 mm ± 0.66 in Kontur AB groups.)

Depth of focus was the other parameter which was compared between eyes implanted with Akreos AO and Kontur AB. Table 4 shows no significant difference for distance-corrected intermediate and near visual acuity, 1 and 3 months postoperatively.

Subjective reports of visual disturbances and light-induced complications of two lenses, 3 months postsurgery are given in Table 5.

Table 3
Mean ± SD of HoRMS, total RMS and Z_4 (μm) in two groups, 1 and 3 months postoperatively.

		Pupil size	Akreos AO	Kantur AB	*p*-value
HoRMS	1 month post op	5 mm	0.31 ± 0.05	0.31 ± 0.04	0.626
		6 mm	0.57 ± 0.08	0.55 ± 0.07	0.758
	3 months post op	5 mm	0.30 ± 0.04	0.30 ± 0.04	0.937
		6 mm	0.58 ± 0.08	0.57 ± 0.09	0.525
Total RMS	1 month post op	5 mm	1.67 ± 0.27	1.71 ± 0.26	0.113
		6 mm	2.79 ± 0.40	2.94 ± 0.37	0.104
	3 months post op	5 mm	1.43 ± 0.26	1.54 ± 0.26	0.094
		6 mm	2.55 ± 0.39	2.72 ± 0.37	0.054
Z (4,0)	1 month post op	5 mm	0.23 ± 0.05	0.24 ± 0.07	0.483
		6 mm	0.43 ± 0.09	0.43 ± 0.11	0.962
	3 months post op	5 mm	0.22 ± 0.05	0.23 ± 0.06	0.26
		6 mm	0.40 ± 0.09	0.41 ± 0.11	0.787

Table 4
Mean distance-corrected visual acuity (LogMAR).

		Akreos AO	Kantur AB	*p*-value
1 month post-op	Intermediate	0.49 ± 0.12	0.52 ± 0.15	0.354
	Near	0.65 ± 0.20	0.69 ± 0.21	0.444
3 months post-op	Intermediate	0.46 ± 0.12	0.49 ± 0.13	0.418
	Near	0.60 ± 0.18	0.65 ± 0.18	0.276

Discussion

Spherical and aspherical IOL designs have been compared in previous studies.[3,6,7]

The results show that mesopic contrast sensitivity and quality of vision can be improved by incorporating aspheric designs.[7] On the other hand, comparing aspherical IOL designs, Johansson and associates[2] showed that the higher perceived quality of vision (with the Akreos AO IOL in their study) could be because of differences in depth of field, IOL material, or IOL design.

Our study was performed to compare quality of vision after implantation of two commonly used IOLs with aspheric designs and hydrophilic acrylic which were both claimed to be

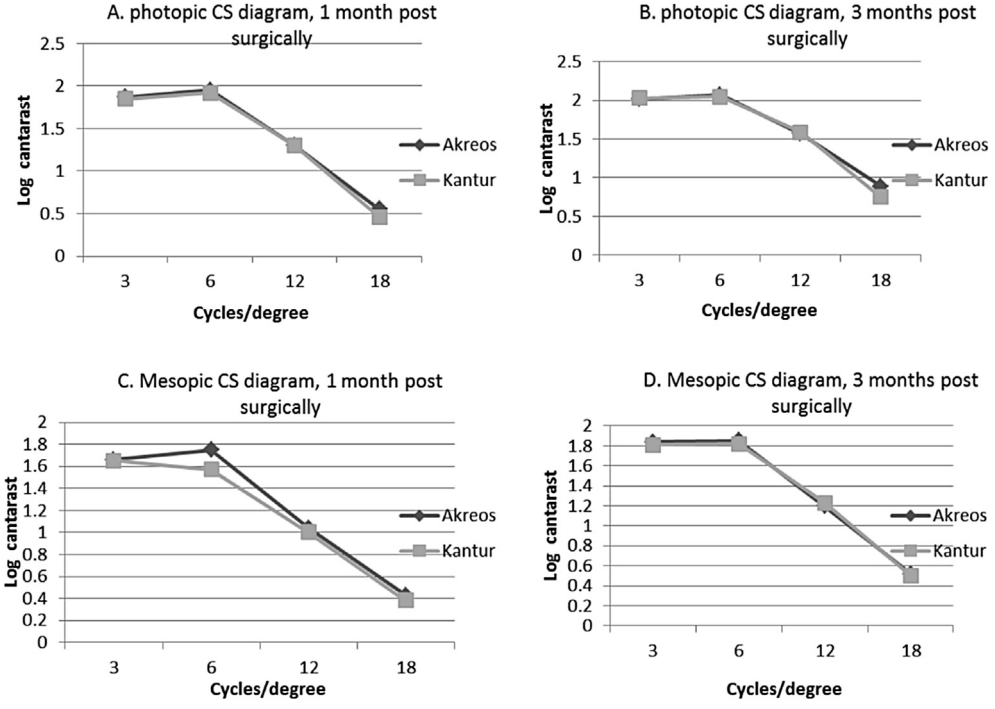

Fig. 1. Comparison of contrast sensitivity changes between 2 groups.

Table 5
Subjective reports of visual complications 3 months post-surgery.

Visual disturbances	Akreos AO				Kantur AB			
	None	Minimal	Annoying	Debilitating	None	Minimal	Annoying	Debilitating
Light induced glare	85.7%	14.3%	0.0%	0.0%	77.2%	22.8%	0.0%	0.0%
Unwanted images	88.6%	11.4%	0.0%	0.0%	82.9%	17.1%	0.0%	0.0%
Increased eye sensitivity	85.7%	14.3%	0.0%	0.0%	77.2%	22.8%	0.0%	0.0%
Driving in to sunset-sunrise	85.7%	14.3%	0.0%	0.0%	85.5%	14.3%	0.0%	0.0%
Bright sunny day at noon	85.7%	14.3%	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%
Brightly lit environment	85.7%	14.3%	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%
Oncoming headlight at night	85.7%	14.3%	0.0%	0.0%	77.2%	22.8%	0.0%	0.0%

aberration free. Akreos AO is a well-known IOL, and previous studies have evaluated and compared it with other IOLs.[3,6,8] We also assessed another aspherical IOL (Kontur AB), which to our knowledge, no study has been conducted on its performance. For minimization of the effects of factors other than the IOLs, such as ocular dominance or refractive deviations, which could affect the outcomes, we implanted each lens in each eye of one patient.[2]

Santiago and associates[3] showed that aspherical Akreos AO IOL, induced lower values of spherical aberration, more patient satisfaction, better performance in the mesopic contrast sensitivity test and similar depth of focus compared with the spherical IOL Akreos Fit (study IOLs).

According to our findings, 3 months postoperatively in relation to 1 month postoperatively, photopic and mesopic contrast sensitivity was increased in both eyes. Three months postoperatively, Akreos photopic contrast sensitivity in high spatial frequencies (18 cycles/deg) was significantly better than Kontur AB, which was in coordination with BCVA.

Like previous studies we used aberrometric analysis as a determinant of postoperative visual function.[1−3,6,7,9−27] Santiago and associates[3] in their study found that eyes implanted with the aspherical IOL Akreos AO showed lower values of spherical aberration and improved contrast sensitivity compared with eyes implanted with the spherical IOL Akreos Fit. By comparing HoRMS, total RMS and Z4 between two eyes (for 5 and 6 mm pupil), we found no significant difference between two lenses, but these factors were decreased 3 months postoperatively in comparison with 1 month postoperatively, which were in relation with postoperative BCVA and contrast sensitivity.

According to previous studies,[7] aspherical IOLs can decrease depth of focus (DoF) and worsen distance-corrected near vision by eliminating spherical aberration that a higher amount of spherical aberration results in a better DoF.[3] In our study, we compared postoperative DoF for two aspherical IOLs. This factor is an important factor in postoperative patient satisfaction. Kontur AB and Akreos AO are considered aberration-free because their anterior and posterior prolate surfaces generate, theoretically, no negative spherical aberration compensate for the positive spherical aberration of the cornea,[2,16] so there is a higher amount of spherical aberration in the optical system. It seems that there will be no significant reduction of depth of focus with that value of spherical aberration.[3] In our work, we incorporated Santiago and associates' technique[3] in which distance-corrected near and intermediate visual acuity were studied as a measurement of depth of focus. Our results showed no significant difference between the two lenses at 1 and 3 months postoperatively.

Also according to results of questionnaire of visual quality, 3 months after surgery more than 75% of patients in both groups had no visual disturbances and light-induced problems.

Obviously, comprehensive studies with larger sample sizes, considering interfering factors in patient satisfaction, can result in a better comparison of these IOLs.

In summary, we concluded that visual quality of Akreos AO and Kontur AB IOLs are similar, and both lenses have the same postoperative patient satisfaction. However, high spatial frequency mesopic and photopic contrast sensitivity and aberrometric findings of Akreos AO are more acceptable.

References

1. The Moorfields, I.O.L.S.G. Binocular implantation of the Tecnis Z9000 orÂ AcrySof MA60AC intraocular lens in routine cataract surgery: prospective randomized controlled trial comparing VF-14 scores. *J Cataract Refrac Surg*. 2007;33:1559−1564.
2. Johansson B, Sundelin S, Wikberg-Matsson A, Unsbo P, Behndig A. Visual and optical performance of the Akreos adapt advanced Optics and Tecnis Z9000 intraocular lenses: Swedish multicenter study. *J Cataract Refrac Surg*. 2007;33:1565−1572.
3. Santhiago MR, Netto MV, Barreto JJ, et al. Wavefront analysis, contrast sensitivity, and depth of focus after cataract surgery with aspherical intraocular lens implantation. *Am J Ophthalmol*. 2010;149:383−389.
4. Chylack LT, Wolfe JK, Singer DM. THe lens opacities classification system iii. *Arch Ophthalmol*. 1993;111:831−836.
5. Tester R, Leon Pace N, Samore M, Olson RJ. Dysphotopsia in phakic and pseudophakic patients: incidence and relation to intraocular lens type. *J Cataract Refrac Surg*. 2000;26:810−816.
6. Jafarinasab MR, Baghi AR, Ziaie H, Yaseri M. Aspheric versus spherical posterior chamber intraocular lenses. *J Ophthalmic Vis Res*. 2010;5:217−222.
7. Nanavaty MA, Spalton DJ, Boyce J, Saha S, Marshall J. Wavefront aberrations, depth of focus, and contrast sensitivity with aspheric and spherical intraocular lenses: fellow-eye study. *J Cataract Refrac Surg*. 2009;35:663−671.
8. Montés-Micó R, Ferrer-Blasco T, Cervino A. Analysis of the possible benefits of aspheric intraocular lenses: review of the literature. *J Cataract Refrac Surg*. 2009;35:172−181.
9. Barbero S, Jiménez-Alfaro I, Marcos S. Optical quality and depth-of-field of eyes implanted with spherical and aspheric intraocular lenses. *J Refract Surg*. 2005;235:223−235.
10. Awwad ST, Lehmann JD, McCulley JP, Bowman RW. A comparison of higher order aberrations in eyes implanted with AcrySof IQ SN60WF and AcrySof SN60AT intraocular lenses. *Eur J Ophthalmol*. 2007;17:320−326.

11. Takmaz T, Genç I, Yıldız Y, Can I. Ocular wavefront analysis and contrast sensitivity in eyes implanted with AcrySof IQ or AcrySof natural intraocular lenses. *Acta Ophthalmol*. 2009;87:759−763.
12. Kurz S, Krummenauer F, Thieme H, Dick HB. Contrast sensitivity after implantation of a spherical versus an aspherical intraocular lens in biaxial microincision cataract surgery. *J Cataract Refrac Surg*. 2007;33:393−400.
13. Ohtani S, Gekka S, Honbou M, et al. One-year prospective intrapatient comparison of aspherical and spherical intraocular lenses in patients with bilateral cataract. *Am J Ophthalmol*. 2009;147:984−989.
14. Ohtani S, Miyata K, Samejima T, Honbou M, Oshika T. Intraindividual comparison of aspherical and spherical intraocular lenses of same material and platform. *Ophthalmology*. 2009;116:896−901.
15. Muñoz G, Albarrán-Diego C, Montés-Micó R, Rodríguez-Galietero A, Alió JL. Spherical aberration and contrast sensitivity after cataract surgery with the Tecnis Z9000 intraocular lens. *J Cataract Refrac Surg*. 2006;32:1320−1327.
16. Nabh R, Ram J, Pandav SS, Gupta A. Visual performance and contrast sensitivity after phacoemulsification with implantation of aspheric foldable intraocular lenses. *J Cataract Refrac Surg*. 2009;35:347−353.
17. Van Gaalen KW, Koopmans SA, Jansonius NM, Kooijman AC. Clinical comparison of the optical performance of aspheric and spherical intraocular lenses. *J Cataract Refrac Surg*. 2010;36:34−43.
18. Tzelikis PF, Akaishi L, Trindade FC, Boteon JE. Ocular aberrations and contrast sensitivity after cataract surgery with AcrySof IQ intraocular lens implantation: clinical comparative study. *J Cataract Refrac Surg*. 2007;33:1918−1924.
19. Lin IC, Wang IJ, Lei MS, Lin LL, Hu FR. Improvements in vision-related quality of life with AcrySof IQ SN60WF aspherical intraocular lenses. *J Cataract Refract Surg*. 2008;34:1312−1317.
20. Kohnen T, Klaproth OK, Bühren J. Effect of intraocular lens asphericity on quality of vision after cataract removal: an intraindividual comparison. *Ophthalmology*. 2009;116:1697−1706.
21. Kasper T, Bühren J, Kohnen T. Visual performance of aspherical and spherical intraocular lenses: intraindividual comparison of visual acuity, contrast sensitivity, and higher-order aberrations. *J Cataract Refract Surg*. 2006;32, 2022-9.
22. Kasper T, Bühren J, Kohnen T. Intraindividual comparison of higher-order aberrations after implantation of aspherical and spherical intraocular lenses as a function of pupil diameter. *J Cataract Refract Surg*. 2006;32:78−84.
23. Denoyer A, Le Lez ML, Majzoub S, Pisella PJ. Quality of vision after cataract surgery after Tecnis Z9000 intraocular lens implantation: effect of contrast sensitivity and wavefront aberration improvements on the quality of daily vision. *J Cataract Refract Surg*. 2007;33:210−216.
24. Cui H, Hu R, Zhang Y, Lou D. Comparison of pseudophakic visual quality in spherical and aspherical intraocular lenses. *Can J Ophthalmol*. 2009;44:274−278.
25. Baumeister M, Bühren J, Kohnen T. Tilt and decentration of spherical and aspheric intraocular lenses: effect on higher-order aberrations. *J Cataract Refract Surg*. 2009;35:1006−1012.
26. Assaf A, Kotb A. Ocular aberrations and visual performance with an aspheric single-piece intraocular lens: contralateral comparative study. *J Cataract Refract Surg*. 2010;36:1536−1542.
27. Alió JL, Piñero DP, Ortiz D, Montalbán R. Clinical outcomes and postoperative intraocular optical quality with a microincision aberration-free aspheric intraocular lens. *J Cataract Refract Surg*. 2009;35:1548−1554.