Clinical Outcomes With a New Continuous Range of Vision Presbyopia-Correcting Intraocular Lens

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ABSTRACT

PURPOSE: To evaluate the clinical outcomes including patient-reported outcome measures in a sample of eyes undergoing bilateral cataract surgery with implantation of a new model of presbyopia-correcting intraocular lens (IOL).

METHODS: This non-randomized prospective case series enrolled 206 eyes of 103 patients undergoing phacoemulsification cataract surgery with bilateral implantation of the TECNIS Synergy IOL (Johnson & Johnson Vision). High and low contrast visual acuity, refractive, defocus curve, and patient-reported visual performance (Catquest-9SF questionnaire) outcomes were evaluated during a 3-month follow-up.

RESULTS: A total of 96.1% (99 of 103) and 91.3% (94 of 103) of patients achieved binocular postoperative uncorrected distance (UDVA) and near visual acuity (UNVA) of 0.00 logMAR (20/20), respectively. Mean postoperative mesopic UNVA for both eyes was 0.14 ± 0.03 logMAR. Likewise, mean binocular UDVA and UNVA were 0.00 ± 0.03 and 0.04 ± 0.02 logMAR. An almost flat mean defocus curve was obtained, with visual acuities between 0.00 and 0.10 logMAR for most defocus levels in both eyes. A reduction of contrast led to a limited but statistically significant change in UNVA in both eyes (P < .001). The Rasch calibrated scoring of item 2 and the Rasch calibrated mean score of the Catquest-9SF questionnaire increased significantly with surgery (P < .001).

CONCLUSIONS: This new presbyopia-correcting IOL provides a continuous range of functional focus, with a limited deterioration under mesopic conditions, which is perceived as a satisfactory outcome by the patient if proper patient selection is performed.

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A fast evolution of presbyopia-correcting intraocular lenses (IOLs) has occurred in recent years, with the popularization of extended depth of focus (EDOF) IOLs[1] and the optimization of diffractive trifocal IOLs.[2-4] A great variety of presbyopia-correcting IOLs have been developed and commercially released, providing different levels of visual rehabilitation.[1-4] The main objective of new IOL designs is to provide the maximum level of range of focus with minimal photic phenomena associated.[1-4] There are many studies reporting the clinical outcomes that can be obtained with all of these new models of presbyopia-correcting IOLs, but few of them perform a valid evaluation of patient-reported outcome measures (PROMs).[1-4] It should be considered that the evaluation of PROMs is crucial to know the real impact of any health intervention, in this case cataract surgery with implantation of a presbyopia-correcting IOL.[5] PROMs can only be correctly evaluated by validated questionnaires developed according to strict and accurate methodology, such as the Catquest-9SF questionnaire.[6]

A new approach has been developed for presbyopia correction by combining two diffractive technologies, an EDOF[7,8] and multifocal diffractive profile in the same lens (TECNIS Synergy; Johnson & Johnson Vision).[9] The theoretical aim of this new design is to deliver continuous high-contrast vision from far through near, even in low-lighting conditions. However, to

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date, there are no scientific reports on the clinical outcomes obtained with this type of IOL, other than those provided by the manufacturer. The aim of the current clinical study was to evaluate the clinical outcomes including PROMs in a sample of eyes undergoing bilateral cataract surgery with implantation of the TECNIS Synergy IOL.

PATIENTS AND METHODS

PATIENTS

This non-randomized prospective case series enrolled 206 eyes of 103 patients undergoing uncomplicated phacoemulsification cataract surgery with bilateral implantation of the presbyopia-correcting TECNIS Synergy IOL. Before surgery, all patients were adequately informed about the study and signed a consent form in accordance with the tenets of the Declaration of Helsinki. The study was approved by the Svjetlost Hospital (Zagreb, Croatia) ethics committee. Inclusion criteria were patients with cataract seeking spectacle independence and predicted postoperative astigmatism of 0.75 diopters (D) or less. Exclusion criteria were previous ocular surgery, active or systemic ocular pathology, irregular corneal astigmatism, abnormal iris, and antecedents of ocular conditions such as glaucoma, uveitis, or retinal problems. During the initial visit, all patients were warned about well-known limits and issues with presbyopia-correcting IOLs to ensure the full understanding of the goal of presbyopia-correcting IOLs: spectacle independence while minimizing side effects. Patients who were not fully ready to commit to this technology were rejected for presbyopia-correction IOL surgery and were advised to either continue with spectacle use or undergo monofocal IOL surgery. Key factors for patient selection were the following: motivation, patients requesting presbyopia correction, stable and good tear film, scotopic pupil size of less than 6 mm, no pathology associated, and acceptance of the limitations of the technology in the worst-case scenario (photic phenomena).

CLINICAL EXAMINATIONS

A complete preoperative ophthalmological examination was performed in all patients, including manifest distance and near refraction, measurement of monocular uncorrected (UDVA) and corrected (CDVA) distance visual acuity, measurement of uncorrected (UNVA) and distance-corrected near (DCNVA) visual acuity at 40 cm, optical biometry and keratometry (IOLMaster 700; Carl Zeiss Meditec), Pentacam HR analysis of the cornea (Oculus Optikgeräte GmbH), slit-lamp examination, Goldmann applanation tonometry, indirect ophthalmoscopy, and measurement of the impact of the visual function on the patient's daily life with a validated questionnaire. Specifically, the Catquest-9SF questionnaire was used, which is a Rasch-analyzed, short, and highly responsive patient questionnaire for use in cataract surgery that measures activity limitations in daily life caused by cataract.[6] This questionnaire was found in a comparative study to be the most responsive to cataract surgery among 16 commonly used Rasch-scaled cataract surgery questionnaires.[10]

Postoperatively, patients were evaluated at 1 day, 1 week, 1 month, and 3 months after surgery. The examination the day after surgery included UDVA measurement, tonometry, and examination of the integrity of the anterior segment. At 1 week and 1 month postoperatively, monocular UDVA and UNVA measurement, slit-lamp biomicroscopy, applanation tonometry, and autorefraction were performed. At the end of the follow-up period, a complete eye examination was performed including the following measurements: monocular and binocular UDVA, monocular CDVA, manifest refraction, monocular (under photopic and mesopic conditions, 85 and 3 cd/m^2) and binocular UNVA, monocular CNVA, monocular low-contrast visual acuity at near (40 cm, 10% and 25% contrasts) using the Pelli-Robson test (Precision Vision), monocular evaluation of defocus curve to evaluate the range of functional function (defocus introduced in 0.50-D steps from +0.50 to -3.50 D), and subjective evaluation of the vision-related daily activity limitations with the Catquest-9SF questionnaire. Likewise, patients were asked verbally if they perceived disturbing halos, because it is one of the most disturbing phenomena reported by patients who have multifocal IOL implantation.[1]

SURGERY

All surgeries were performed by the same experienced surgeon with more than 40,000 cataract procedures (NG) using a standard technique of sutureless microincision phacoemulsification. First, anesthesia and mydriatic drops were instilled and the surgery was initiated with the creation of the corneal incision at the temporal area. After this, the capsulorhexis was created manually and the phacoemulsification was performed. Finally, the IOL was inserted into the capsular bag through the main incision using the injector developed by the manufacturer for this purpose. A combination of topical antibiotic and steroid was prescribed to be applied postoperatively four times daily for 1 week.

IOL

The TECNIS Synergy IOL is a one-piece presbyopia-correcting IOL with a 6-mm optic and an overall length of 13 mm. It has C-loop haptics with offset from optics and

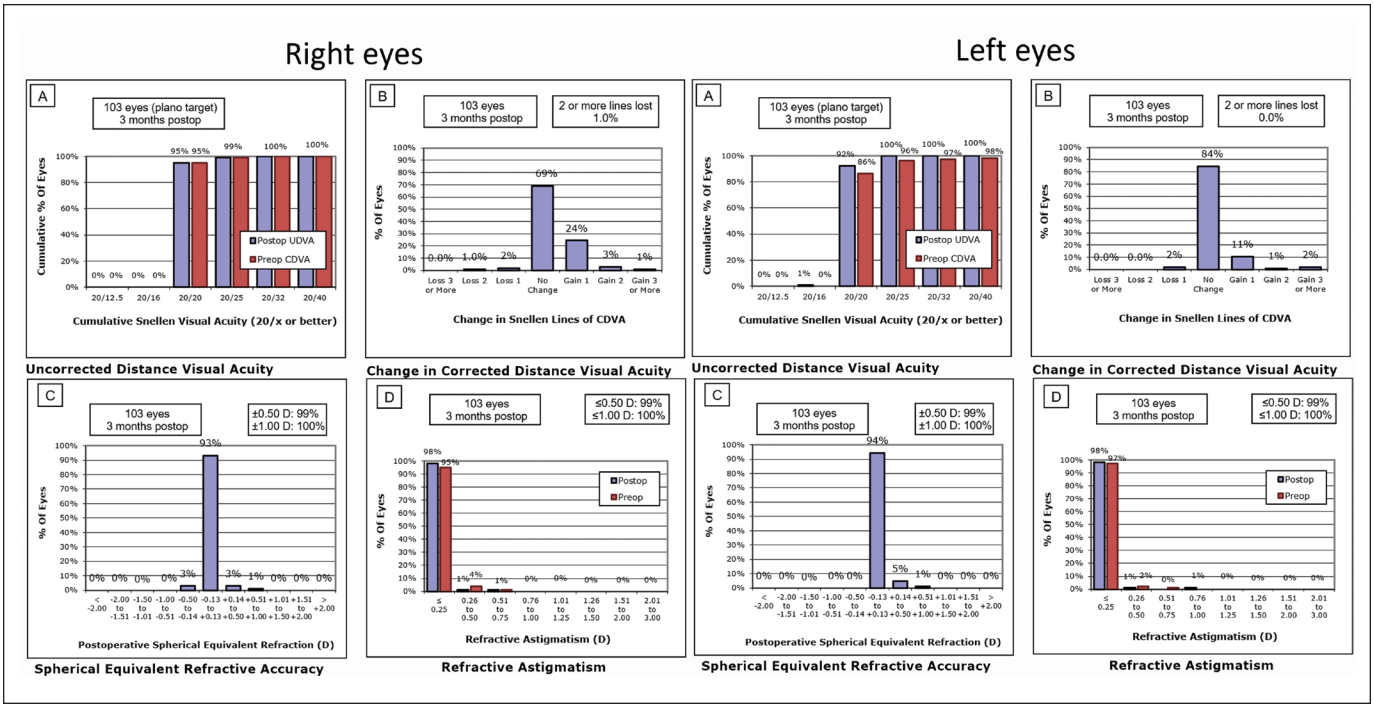

Figure 1. Standard graphs for reporting the refractive outcomes in the sample of right and left eyes implanted with the intraocular lens evaluated: (A) uncorrected distance visual acuity (UDVA); (B) UDVA vs corrected distance visual acuity (CDVA); (C) spherical equivalent refraction accuracy; and (D) postoperative refractive cylinder. D = diopters

a continuous 360° posterior square edge. It is made of a hydrophobic acrylic material with ultraviolet and violet light absorber; it has a refractive index of 1.47. The design of the IOL is based on a proprietary diffractive design resulting from the combination of diffractive technologies of TECNIS multifocal and TECNIS Symfony IOLs. Specifically, the IOL features an echelette profile, where height and spacing of the diffractive zones determine the distribution of light and, ultimately, the vision delivered. The profile is modified such that zones are optimized to alter the phases of light. The constructive interference of light from these zones elongates focus and optimizes distance vision. There is no distinct add power. The company labelled A-constant for this IOL is 119.3. In the current study, power calculations for this IOL were performed using the Barrett Universal II (BU-II) formula (2010, Graham D. Barrett) and considering the target refraction emmetropia in all cases.

Data Analysis

The commercially available software package SPSS (version 20.0; SPSS, Inc, IBM Corporation) was used to perform the statistical analyses with the data obtained in the clinical study. Normality of data samples was evaluated by the Kolmogorov-Smirnov test. When parametric analysis was possible, the *t* test for paired data was used for the analysis of differences between preoperative and postoperative visits, whereas the Wilcoxon ranked-sum test was used when the data samples were not normally distributed. Data from the right and left eyes of each patient were analyzed separately because data from fellow eyes are normally correlated and this can introduce a significant level of bias. Likewise, the standard graphs for reporting the refractive outcomes of IOL-based surgery were generated.[11] A *P* value less than .05 was considered statistically significant.

RESULTS

A total of 206 eyes from 103 patients with ages ranging from 35 to 75 years were included in the study. A total of 50 (48.5%) patients were men and 53 (51.5%) were women. Mean IOL power implanted was 21.69 ± 2.99 D (median: 22.50 D; range: 11.50 to 28.50 D) and 21.78 ± 3.22 D (median: 22.50 D; range: 10.00 to 29.50 D) in the right and left eyes, respectively. **Table A** (available in the online version of this article) summarizes the preoperative and 3-month postoperative monocular visual and refractive data.

Visual and Refractive Outcomes

Figure 1 shows the standard graphs reporting the visual and refractive outcomes in both eyes after cataract surgery with the IOL evaluated. A significant reduction was observed in sphere and spherical equivalent at 3 months after surgery in both eyes ($P \leq .026$), with a signif-

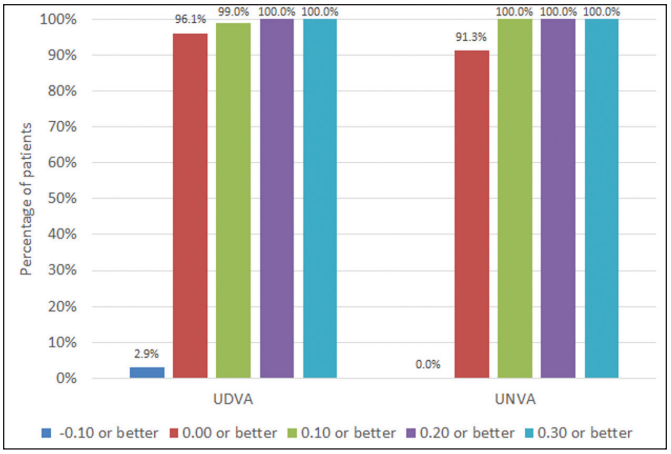

Figure 2. Distribution of 3-month postoperative binocular uncorrected distance (UDVA) and near (UNVA) visual acuity data in the analyzed sample.

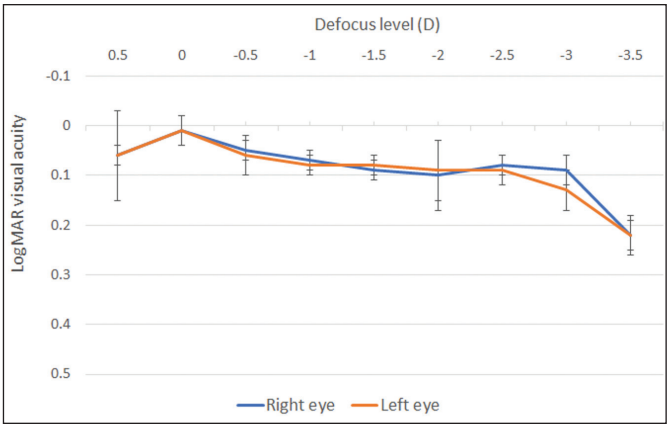

Figure 3. Mean defocus curve obtained at 3 months after surgery in right and left eyes of patients enrolled in the study. D = diopters

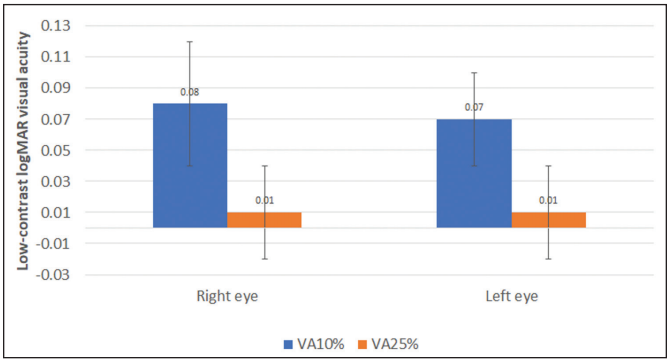

Figure 4. Distance visual acuity (VA) thresholds measured for contrasts of 10% and 25% at 3 months after surgery in right and left eyes of patients enrolled in the study.

icant improvement in UDVA ($P < .001$), CDVA ($P \leq .001$), UNVA ($P < .001$), and CNVA ($P < .001$) (**Table A**). A total of 99.0% (204 of 206) and 100.0% (206 of 206) of eyes had a spherical equivalent within ±0.50 and ±1.00 D at 3 months after surgery, respectively. A total of 99.0% (102 of 103) and 100.0% (103 of 103) of right and left eyes, respectively, achieved UDVA of 0.10 logMAR (20/25) or better at 3 months after surgery. Likewise, 100.0% (103 of 103) and 99.0% (102 of 103) of right and left eyes, respectively, achieved a 3-month postoperative UNVA of 0.10 (20/25) logMAR or better.

Mean mesopic UNVA for both eyes was 0.14 ± 0.03 logMAR (between 20/25 and 20/32) (median: 0.15 logMAR; range: 0.05 to 0.20 logMAR). Differences between photopic and mesopic measures of UNVA reached statistical significance, but the magnitude of the difference was small (0.04 logMAR in the right eye, 0.05 logMAR in the left eye). Mean binocular UDVA and UNVA at 3 months after surgery were 0.00 ± 0.03 (20/20) (median: 0.00 logMAR; range: -0.10 to 0.20 logMAR) and 0.04 ± 0.02 logMAR (between 20/20 and 20/25) (median: 0.05 logMAR; range: 0.00 to 0.12 logMAR), respectively. A total of 96.1% (99 of 103) and 91.3% (94 of 103) of patients achieved binocular postoperative UDVA and UNVA of 0.00 logMAR (20 of 20), respectively (**Figure 2**).

Defocus Curve Outcomes

Figure 3 shows the mean defocus curve measured at 3 months after surgery in the right and left eyes of patients enrolled in the study. As shown, an almost flat curve is obtained, with visual acuities between 0.00 (20/20) and 0.10 (20/25) logMAR for most defocus levels in both eyes. No statistically significant difference was found between visual acuities obtained for defocus levels of -1.00 and -2.50 D in right eyes ($P = .088$). However, this difference reached statistical significance in left eyes ($P < .001$).

Low Contrast Near Visual Acuity Outcomes

Figure 4 shows the distance visual acuity thresholds measured for contrasts of 10% and 25% at 3 months after surgery in right and left eyes of patients enrolled in the study. The reduction of contrast led to a limited change of acuity threshold in both eyes, although this change reached statistical significance ($P < .001$).

PROMS

Table 1 shows the results obtained with the Catquest-9SF questionnaire preoperatively and at 3 months after surgery. A statistically significant increase was found in the Rasch calibrated scoring of item 2 and in the Rasch calibrated mean score ($P < .001$).

Complications

In a total of 18 cases (8.7%), significant posterior capsular opacification was present and Nd:YAG capsulotomy was required mainly due to distance vision problems, but not at near. Indeed, significantly worse 3-month postoperative UDVA and CDVA was found in the groups of eyes with posterior capsular opacifica-

TABLE 1

Summary of the Preoperative and Postoperative Data Obtained With the Catquest-9SF Questionnaire in the Sample Evaluated

Parameter	Preoperative	3 Months Postoperative	*P*
Rasch calibrated item 2			< .001
Mean ± SD	-0.04 ± 0.77	4.57 ± 0.43	
Median (range)	0.20 (-2.53 to 0.20)	4.67 (2.67 to 4.67)	
Rasch calibrated Catquest-9SF score			< .001
Mean ± SD	-0.05 ± 1.14	3.51 ± 0.05	
Median (range)	0.54 (-3.30 to 0.87)	3.52 (3.30 to 3.52)	

SD = standard deviation

tion compared to the rest ($P = .023$), whereas no significant differences between these groups were found in UNVA and CNVA ($P \geq .821$) (**Figure A**, available in the online version of this article).

Disturbing halos were only reported by 2 patients (1.9%) enrolled in the study, with complaints during night driving in only 1 (1.0%) of these 2 patients. Specifically, the following question was asked of all patients: "Are you noticing halos that you find disturbing or bothersome? In which conditions are they more disturbing?" Significant residual error was treated by laser corneal refractive surgery in 4 eyes (1.9%). The presence of residual cylinder was clearly related to worse visual acuity outcomes. **Table B** (available in the online version of this article) shows the visual results of the 4 eyes (2 right eyes and 2 left eyes) with 3-month postoperative residual astigmatism. As shown, this refractive error had a significant negative impact on UDVA and near visual acuity under low light or low contrast conditions.

DISCUSSION

The presbyopia-correcting IOL evaluated has been demonstrated in the current series to provide excellent distance visual acuities, with mean binocular 3-month postoperative UDVA of 0.00 ± 0.03 logMAR. This was consistent with the high levels of refractive predictability achieved, with almost all eyes (99%) having a postoperative spherical equivalent within ±0.50 D. These results were consistent with or even better than those reported with other models of multifocal IOLs.[12-19] Likewise, the UDVA and CDVA outcomes obtained were also similar to those found with EDOF IOLs, confirming the excellent optical performance of this new presbyopia-correcting IOL for distance foci.[12,17,19,20] Manifest residual cylinders of 0.50 D or greater were found to have a significant impact on distance visual outcomes. This result is consistent with those obtained in 2018 by Berdahl et al,[21] who demonstrated that a mean worsening of UDVA of approximately 0.16 logMAR could be expected per diopter of residual astigmatism after cataract surgery with implantation of a multifocal IOL. Likewise, Zheleznyak et al[22] concluded in an experimental study that residual astigmatisms of more than 0.75 D in eyes implanted with multifocal IOLs could significantly degrade the visual quality and the depth of focus induced by such IOLs. Therefore, accurate IOL power calculations and the control of corneal astigmatism seem to be crucial factors to optimize the results that can be obtained with this new presbyopia-correcting IOL evaluated. Concerning changes in distance visual acuity when decreasing contrast, a minimal change was observed for the measurement of visual acuity using 25% contrast, confirming that distance visual resolution was maintained even in adverse conditions. When the contrast was decreased to 10%, a change of less than one logMAR line was found in UDVA. These changes in visual acuity measured using low contrast optotypes are clearly lower than those reported in eyes implanted with EDOF[23] and multifocal[24] IOLs.

In our series, mean monocular and binocular UNVA were 0.09 ± 0.03 and 0.04 ± 0.02 logMAR, respectively, which is an excellent outcome considering that no myopic residual error was present practically in any patient. This supposes that the level of distance visual acuity was close to that achieved at near. These results are clearly better than those reported for EDOF IOLs,[12,17,19,20] and also for most multifocal IOLs previously evaluated.[9,12-15,17,19,25-28] Fernández et al[15] reported a mean monocular UNVA of 0.24 ± 0.14 logMAR in a sample of 30 eyes implanted with the trifocal diffractive Versario 3F IOL (Bausch & Lomb). For the trifocal diffractive AT LISA tri IOL (Carl Zeiss Meditec), mean 3-month monocular UNVA values of 0.22 ± 0.0725 and 0.22 ± 0.1126 logMAR have been reported in two previously published studies. Likewise, mean 3-month postoperative monocular UNVA of 0.17 ± 0.1227 and 0.21 ± 0.16 logMAR have been obtained for the trifocal diffractive IOLs PanOptix (Alcon Laboratories, Inc) and FineVision (PhysIOL),[28] respectively. In our series, low contrast monocular UNVA was also found to be in the levels of photopic values reported for other multifocal IOLs, with only a loss of half of a logMAR line (0.05 logMAR) with the worsening of light conditions. It should be considered that a clinically significant deterioration of UNVA after implantation of other multifocal IOLs have been found when measured under mesopic illumination conditions.[29]

With the analysis of monocular defocus curves in the current series, the extension of depth of focus generated by the IOL evaluated could be confirmed. Mean visual acuity was below 0.10 logMAR for all defocus levels until -2.50 D (flat profile), revealing stability of a completely functional visual acuity across most distances used for our common daily activities.[30] Indeed, no statistically significant differences were found between visual acuities obtained for defocus levels of -1.00 and -2.50 D in right eyes. This contrast with the defocus curves was reported for most presbyopia-correcting IOLs (especially bifocals), which showed a more or less relevant decrease of visual acuity in the intermediate defocus range.[12-20,25-28] This continuous range of focus may be the main reason explaining the great subjective improvement reported by the patient as evaluated with the Catquest-9SF questionnaire. Indeed, the improvement observed in the Rasch calibrated scoring of item 2 and the Rasch calibrated mean score in our series was higher than that observed in previous studies evaluating the PROMs after cataract surgery with implantation of monofocal IOLs.[31] This trend to obtain better Catquest-9SF questionnaire scores with multifocal IOLs compared to monofocal IOLs has also been reported in previous comparative studies, suggesting that achieving visual rehabilitation at different distances is a critical factor for improving the perception of the patient's visual function after cataract surgery.[31]

Finally, complications were also evaluated during the follow-up of patients enrolled in the study. In 8.7% of eyes, capsulotomy was required due to the presence of some level of posterior capsular opacification affecting especially distance visual acuity. This is consistent with previous studies demonstrating that earlier loss of visual function (significant visual degradation with mild changes of the capsule) can be present in eyes implanted with diffractive multifocal IOLs.[32] The posterior capsular opacification rate is in the range of rates reported for other diffractive multifocal IOLs.[26,33] More studies are required to confirm this outcome, analyzing in detail the level of susceptibility to posterior capsule changes of the visual performance achieved with this new presbyopia-correcting IOL. In addition, disturbing halos were only reported by 2 patients (1.9%), which suggests a limited incidence of photic phenomena after the implantation of this new presbyopia-correcting IOL. This incidence is lower than that reported for other models of diffractive and multifocal IOLs.[34-37] Considering that the IOL provides a continuous range of focus and that a similar level of defocus is present in retina when focusing at different distances, the low level of disturbance due to photic phenomena seems reasonable. However, this should be confirmed in future comparative clinical trials evaluating the perception of photic phenomena using validated questionnaires. The authors strongly believe that patient counseling and patient selection is crucial. In our opinion, presbyopia-correcting IOLs should only be offered to highly motivated patients who are able to understand the compromises of technology against the gains in spectacle independence.

The TECNIS Synergy IOL provides an effective visual rehabilitation, with a continuous range of focus across distances that are commonly used in our daily life and minimal incidence of photic phenomena. This is associated with a positive self-evaluation of the visual performance achieved with surgery if appropriate patient selection is performed. Future comparative clinical trials are needed to confirm the benefits of this new presbyopia-correcting IOL over other previously released presbyopia-correcting IOLs. Also, there is a need to explore expected results in patients who fall outside the average IOL power delivery range, because in our series most of patients were implanted with IOLs powered between 21.00 and 22.00 D, corresponding to patients with keratometicy values below 40.00 and above 45.00 D.

AUTHOR CONTRIBUTIONS

Study concept and design (NG, IG, MB); data collection (NG, IG, KG, AB, MB); analysis and interpretation of data (NG, IG, DPP, MB); writing the manuscript (DPP); critical revision of the manuscript (NG, IG, KG, AB, MB); statistical expertise (DPP); administrative, technical, or material support (NG, IG, KG, AB, MB); supervision (NG, IG, KG, AB, DPP, MB)

REFERENCES

1. Liu J, Dong Y, Wang Y. Efficacy and safety of extended depth of focus intraocular lenses in cataract surgery: a systematic review and meta-analysis. *BMC Ophthalmol.* 2019;19(1):198. doi:10.1186/s12886-019-1204-0
2. Zamora-de La Cruz D, Zúñiga-Posselt K, Bartlett J, Gutierrez M, Abariga SA. Trifocal intraocular lenses versus bifocal intraocular lenses after cataract extraction among participants with presbyopia. *Cochrane Database Syst Rev.* 2020;6:CD012648.
3. Ribeiro F, Ferreira TB. Comparison of clinical outcomes of three trifocal intraocular lenses. *J Cataract Refract Surg.* 2020;46(9):1247-1252. doi:10.1097/j.jcrs.0000000000000212
4. Palomino-Bautista C, Sánchez-Jean R, Carmona-González D, Piñero DP, Molina-Martín A. Subjective and objective depth of field measures in pseudophakic eyes: comparison between extended depth of focus, trifocal and bifocal intraocular lenses. *Int Ophthalmol.* 2020;40(2):351-359. doi:10.1007/s10792-019-01186-6
5. Lundström M, Stenevi U. Analyzing patient-reported outcomes to improve cataract care. *Optom Vis Sci.* 2013;90(8):754-759. doi:10.1097/OPX.0b013e3182956c32
6. Lundström M, Pesudovs K. Catquest-9SF patient outcomes questionnaire: nine-item short-form Rasch-scaled revision of the Catquest questionnaire. *J Cataract Refract Surg.* 2009;35(3):504-513. doi:10.1016/j.jcrs.2008.11.038
7. Lee Y, Labuz G, Son HS, Yildirim TM, Khoramnia R, Auffarth

GU. Assessment of the image quality of extended depth-of-focus intraocular lens models in polychromatic light. *J Cataract Refract Surg*. 2020;46(1):108-115. doi:10.1097/j.jcrs.0000000000000037

8. Tognetto D, Cecchini P, Giglio R, Turco G. Surface profiles of new-generation IOLs with improved intermediate vision. *J Cataract Refract Surg*. 2020;46(6):902-906.
9. Altemir-Gomez I, Millan MS, Vega F, et al. Comparison of visual and optical quality of monofocal versus multifocal intraocular lenses. *Eur J Ophthalmol*. 2020;30(2):299-306. doi:10.1177/1120672119827858
10. McAlinden C, Gothwal VK, Khadka J, Wright TA, Lamoureux EL, Pesudovs K. A head-to-head comparison of 16 cataract surgery outcome questionnaires. *Ophthalmology*. 2011;118(12):2374-2381. doi:10.1016/j.ophtha.2011.06.008
11. Reinstein DZ, Archer TJ, Srinivasan S, et al. Standard for reporting refractive outcomes of intraocular lens-based refractive surgery. *J Refract Surg*. 2017;33(4):218-222. doi:10.3928/1081597X-20170302-01
12. Gil MA, Varón C, Cardona G, Buil JA. Visual acuity and defocus curves with six multifocal intraocular lenses. *Int Ophthalmol*. 2020;40(2):393-401. doi:10.1007/s10792-019-01196-4
13. Calvo-Sanz JA, Sánchez-Tena MA. Characterization of optical performance with defocusing curve: analysis of two refractive intraocular lens models with high and medium addition. *J Optom*. 2020;13(1):35-40. doi:10.1016/j.optom.2018.10.003
14. Law EM, Aggarwal RK, Buckhurst H, et al. Visual function and subjective perception of vision following bilateral implantation of monofocal and multifocal intraocular lenses: randomized controlled trial. *J Cataract Refract Surg*. 2020;46(7):1020-1029. doi:10.1097/j.jcrs.0000000000000210
15. Fernández J, Rodríguez-Vallejo M, Martínez J, Tauste A, Piñero DP. Standard clinical outcomes with a new low addition trifocal intraocular lens. *J Refract Surg*. 2019;35(4):214-221. doi:10.3928/1081597X-20190306-01
16. Kim KH, Kim WS. Visual outcome and patient satisfaction of low-power-added multifocal intraocular lens. *Eye Contact Lens*. 2018;44(1):60-67. doi:10.1097/ICL.0000000000000314
17. Cochener B, Boutillier G, Lamard M, Auberger-Zagnoli C. A comparative evaluation of a new generation of diffractive trifocal and extended depth of focus intraocular lenses. *J Refract Surg*. 2018;34(8):507-514. doi:10.3928/1081597X-20180530-02
18. Fernández J, Rodríguez-Vallejo M, Martínez J, Tauste A, Piñero DP. Biometric factors associated with the visual performance of a high addition multifocal intraocular lens. *Curr Eye Res*. 2018;43(8):998-1005. doi:10.1080/02713683.2018.1478981
19. Pedrotti E, Carones F, Aiello F, et al. Comparative analysis of visual outcomes with 4 intraocular lenses: monofocal, multifocal, and extended range of vision. *J Cataract Refract Surg*. 2018;44(2):156-167. doi:10.1016/j.jcrs.2017.11.011
20. Savini G, Schiano-Lomoriello D, Balducci N, Barboni P. Visual performance of a new extended depth-of-focus intraocular lens compared to a distance-dominant diffractive multifocal intraocular lens. *J Refract Surg*. 2018;34(4):228-235. doi:10.3928/1081597X-20180125-01
21. Berdahl JP, Hardten DR, Kramer BA, Potvin R. Effect of astigmatism on visual acuity after multifocal versus monofocal intraocular lens implantation. *J Cataract Refract Surg*. 2018;44(10):1192-1197. doi:10.1016/j.jcrs.2018.06.048
22. Zheleznyak L, Kim MJ, MacRae S, Yoon G. Impact of corneal aberrations on through-focus image quality of presbyopia-correcting intraocular lenses using an adaptive optics bench system. *J Cataract Refract Surg*. 2012;38(10):1724-1733. doi:10.1016/j.jcrs.2012.05.032
23. Pilger D, Homburg D, Brockmann T, Torun N, Bertelmann E, von Sonnleithner C. Clinical outcome and higher order aberrations after bilateral implantation of an extended depth of focus intraocular lens. *Eur J Ophthalmol*. 2018;28(4):425-432. doi:10.1177/1120672118766809
24. Puell MC, Pérez-Carrasco MJ, Hurtado-Ceña FJ, Álvarez-Rementería L. Disk halo size measured in individuals with monofocal versus diffractive multifocal intraocular lenses. *J Cataract Refract Surg*. 2015;41(11):2417-2423. doi:10.1016/j.jcrs.2015.04.030
25. Marques EF, Ferreira TB. Comparison of visual outcomes of 2 diffractive trifocal intraocular lenses. *J Cataract Refract Surg*. 2015;41(2):354-363. doi:10.1016/j.jcrs.2014.05.048
26. Mojzis P, Majerova K, Hrckova L, Piñero DP. Implantation of a diffractive trifocal intraocular lens: one-year follow-up. *J Cataract Refract Surg*. 2015;41(8):1623-1630. doi:10.1016/j.jcrs.2014.11.050
27. Alió JL, Plaza-Puche AB, Alió Del Barrio JL, et al. Clinical outcomes with a diffractive trifocal intraocular lens. *Eur J Ophthalmol*. 2018;28(4):419-424. doi:10.1177/1120672118762231
28. Jonker SM, Bauer NJ, Makhotkina NY, Berendschot TTJ, van den Biggelaar FJM, Nuijts RM. Comparison of a trifocal intraocular lens with a +3.0 D bifocal IOL: results of a prospective randomized clinical trial. *J Cataract Refract Surg*. 2015;41(8):1631-1640. doi:10.1016/j.jcrs.2015.08.011
29. Cillino G, Casuccio A, Pasti M, Bono V, Mencucci R, Cillino S. Working-age cataract patients: visual results, reading performance, and quality of life with three diffractive multifocal intraocular lenses. *Ophthalmology*. 2014;121(1):34-44. doi:10.1016/j.ophtha.2013.06.034
30. Soler F, Sánchez-García A, Molina-Martin A, de Fez D, Díaz V, Piñero DP. Characterization of working and mobile phone usage distances in common users of electronic devices and computers. *Int J Ophthalmol*. In press.
31. Harrer A, Gerstmeyer K, Hirnschall N, Pesudovs K, Lundström M, Findl O. Impact of bilateral cataract surgery on vision-related activity limitations. *J Cataract Refract Surg*. 2013;39(5):680-685. doi:10.1016/j.jcrs.2012.11.028
32. Elgohary MA, Beckingsale AB. Effect of posterior capsular opacification on visual function in patients with monofocal and multifocal intraocular lenses. *Eye (Lond)*. 2008;22(5):613-619. doi:10.1038/sj.eye.6702661
33. Mojzis P, Kukuckova L, Majerova K, Ziak P, Piñero DP. Postoperative visual performance with a bifocal and trifocal diffractive intraocular lens during a 1-year follow-up. *Int J Ophthalmol*. 2017;10(10):1528-1533.
34. Royo M, Jiménez Á, Piñero DP. Clinical outcomes of cataract surgery with implantation of a continuous transitional focus intraocular lens. *J Cataract Refract Surg*. 2020;46(4):567-572. doi:10.1097/j.jcrs.0000000000000108
35. Buckhurst PJ, Naroo SA, Davies LN, Shah S, Drew T, Wolffsohn JS. Assessment of dysphotopsia in pseudophakic subjects with multifocal intraocular lenses. *BMJ Open Ophthalmol*. 2017;1(1):e000064. doi:10.1136/bmjophth-2016-000064
36. Maurino V, Allan BD, Rubin GS, Bunce C, Xing W, Findl O; Moorfields IOL Study Group. Quality of vision after bilateral multifocal intraocular lens implantation: a randomized trial—AT LISA 809M versus AcrySof ReSTOR SN6AD1. *Ophthalmology*. 2015;122(4):700-710. doi:10.1016/j.ophtha.2014.10.002
37. Muñoz G, Albarrán-Diego C, Ferrer-Blasco T, Sakla HF, García-Lázaro S. Visual function after bilateral implantation of a new zonal refractive aspheric multifocal intraocular lens. *J Cataract Refract Surg*. 2011;37(11):2043-2052. doi:10.1016/j.jcrs.2011.05.045

TABLE A

Summary of the Preoperative and Postoperative Monocular Visual and Refractive Data of the Analyzed Sample

	Right Eye			Left Eye		
Parameter	**Preoperative**	**3 Months Postoperative**	***P***	**Preoperative**	**3 Months Postoperative**	***P***
UDVA (logMAR)			< .001			< .001
Mean ± SD	0.53 ± 0.34	0.01 ± 0.03		0.52 ± 0.33	0.01 ± 0.03	
Median (range)	0.50 (0.00 to 1.50)	0.00 (0.00 to 0.20)		0.50 (0.00 to 1.50)	0.00 (-0.10 to 0.15)	
CDVA (logMAR)			.001			< .001
Mean ± SD	0.04 ± 0.06	0.01 ± 0.03		0.04 ± 0.07	0.01 ± 0.03	
Median (range)	0.02 (0.00 to 0.50)	0.00 (0.00 to 0.20)		0.02 (0.00 to 0.40)	0.00 (-0.10 to 0.15)	
Sphere (D)			.003			.023
Mean ± SD	0.69 ± 2.30	0.02 ± 0.12		0.63 ± 2.52	0.03 ± 0.14	
Median (range)	1.25 (-7.00 to 4.00)	0.00 (-0.50 to 0.75)		1.25 (-8.00 to 5.75)	0.00 (0.00 to 1.00)	
Cylinder (D)			.207			.754
Mean ± SD	-0.03 ± 0.12	-0.01 ± 0.09		-0.02 ± 0.11	-0.02 ± 0.11	
Median (range)	0.00 (-0.75 to 0.00)	0.00 (-0.75 to 0.00)		0.00 (-0.75 to 0.00)	0.00 (-1.00 to 0.00)	
SE (D)			.004			.026
Mean ± SD	0.68 ± 2.30	0.01 ± 0.13		.62 ± 2.52	0.03 ± 0.14	
Median (range)	1.25 (-7.00 to 4.00)	0.00 (-0.50 to 0.75)		1.25 (-8.00 to 5.75)	0.00 (0.00 to 0.87)	
UNVA (logMAR)			< .001			< .001
Mean ± SD	1.10 ± 0.59	0.09 ± 0.03		1.12 ± 0.59	0.09 ± 0.03	
Median (range)	1.10 (0.00 to 2.00)	0.10 (0.00 to 0.15)		1.10 (0.00 to 2.00)	0.10 (0.00 to 0.20)	
CNVA (logMAR)			< .001			< .001
Mean ± SD	0.10 ± 0.01	0.09 ± 0.03		0.10 ± 0.02	0.09 ± 0.03	
Median (range)	0.10 (0.05 to 0.15)	0.10 (0.00 to 0.20)		0.10 (0.05 to 0.30)	0.10 (0.00 to 0.20)	

UDVA = uncorrected distance visual acuity; SD = standard deviation; CDVA = corrected distance visual acuity; D = diopters; SE = spherical equivalent; UNVA = uncorrected near visual acuity; CNVA = corrected near visual acuity

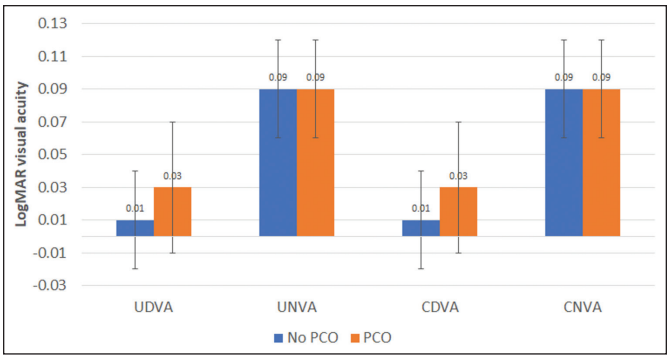

Figure A. Comparison of monocular visual acuities measured at 3 months after surgery in the group of eyes with and without posterior capsular opacification (PCO). UDVA = uncorrected distance visual acuity; UNVA = uncorrected near visual acuity; CDVA = corrected distance visual acuity; CNVA = corrected near visual acuity

TABLE B

Visual Results of the 4 Eyes With 3-Month Postoperative Residual Cylinder

Parameter	Cylinder (D)	UDVA (logMAR)	UNVA (logMAR)	Mesopic UNVA (logMAR)	CS10%	CS25%
Right eye case 1	-0.75	0.20	0.10	0.15	0.23	0.20
Right eye case 2	-0.50	0.10	0.10	0.15	0.10	0.10
Left eye case 3	-0.50	0.15	0.10	0.15	0.20	0.15
Left eye case 4	-1.00	0.12	0.10	0.15	0.15	0.12

D = diopters; UDVA = uncorrected distance visual acuity; UNVA = uncorrected near visual acuity; CS10% = 10% contrast sensitivity; CS25% = 25% contrast sensitivity