

Visual outcomes of patients bilaterally implanted with the extended range of vision intraocular lens: A prospective study

Gitansha Shreyas Sachdev, Shreyas Ramamurthy, Umesh Sharma, Ramamurthy Dandapani

Purpose: The aim of this study was to analyze the objective and subjective visual outcomes of patients bilaterally implanted with the extended range of vision intraocular lens (EROV IOL), the Tecnis Symphony. **Methods:** This was a prospective interventional case series conducted at a tertiary eye care hospital in South India. The study included patients with bilateral implantation of EROV IOLs. The uncorrected and corrected visual acuity for distance, intermediate, and near vision was recorded at 6 weeks and 6 months' postoperative visit. A subjective questionnaire was administered to assess spectacle independence, photic phenomenon, and overall satisfaction. All data were recorded using Microsoft Excel worksheet. The analyses were performed using SPSS for windows software. **Results:** Our study included fifty patients with bilateral implantation of EROV IOLs. The mean age was 59.84 ± 11.68 years. The mean uncorrected binocular distance, intermediate, and near visual acuity (in standard decimal equivalent) was 0.89, 0.99 and 0.99 respectively, at 6 months' postoperative visit. Ninety-six percent of the patients did not require spectacles for distance and 98% of the patients were free from spectacles for intermediate and near vision. 94% of our patients perceived no or minimal photic phenomena such as glare and halos. The mean subjective patient satisfaction score (out of 10) for distance, intermediate, and near was 9, 10, and 9, respectively. **Conclusion:** The EROV IOLs demonstrated high levels of spectacle independence for distance, intermediate, and near vision. The incidence of photic phenomena observed was minimal with a high level of patient satisfaction.

Key words: Extended depth of focus, extended range of vision intraocular lens, intraocular lens, multifocal intraocular lens

With advancements in technology and increased patient awareness, cataract surgery is fast evolving into a refractive procedure. Multifocal intraocular lenses (IOLs) afford postoperative spectacle independence by providing good visual acuity for both distance and near vision.^[1] Traditional diffractive multifocal IOLs provide two distinct foci; one for distance and the other for near. They work on the principle of simultaneous vision which means at any point of time, one sharp image and another blurred image is projected onto the retina. Although one is able to suppress the blurred image and view the other image clearly in most situations, the out of focus image can produce dysphotopsia in dim illumination.^[2-4]

A new concept of extended range of vision IOLs (EROV IOLs) has been designed to overcome limitations associated with traditional IOLs correcting presbyopia. This technology uses an elongated continuous range of focus and proprietary achromatic diffractive echelette design with an aim to provide superior visual results.

The aim of the current study was to analyze the subjective and objective visual outcomes of patients bilaterally implanted with the extended range of vision Tecnis Symphony IOL (Abbott Medical Optics, Inc.).

The Eye Foundation, Coimbatore, Tamil Nadu, India

Correspondence to: Dr. Gitansha Shreyas Sachdev, The Eye Foundation, 582A, DB Road, RS Puram, Coimbatore - 641 002, Tamil Nadu, India. E-mail: sachdevgitansha@gmail.com

Manuscript received: 15.09.17; **Revision accepted:** 26.11.17

Access this article online

Website:

www.ijo.in

DOI:

10.4103/ijo.IJO_813_17

Quick Response Code:



Methods

The study adhered to the tenets of the Declaration of Helsinki and an approval was obtained by the Ethics Committee of Our Institute. Informed consent was obtained from all the participants included in the study.

Patients with bilateral decrease of visual acuity attributed solely to cataract, seeking freedom from glasses postcataract surgery were included in the study. Other inclusion criteria included age >18 years and the availability to attend regular follow-up visits.

Exclusion criteria included ocular morbidities with a potential to affect visual outcomes, preoperative refractive astigmatism of -0.75 diopter or greater, previous ocular surgeries, amblyopia, and capsular or zonular abnormalities leading to potential postoperative IOL decentration or tilt.

Surgical technique

All surgeries were performed by the same experience surgeon (DR) under topical anesthesia using either standard

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

Cite this article as: Sachdev GS, Ramamurthy S, Sharma U, Dandapani R. Visual outcomes of patients bilaterally implanted with the extended range of vision intraocular lens: A prospective study. Indian J Ophthalmol 2018;66:407-10.

phacoemulsification or femtosecond laser-assisted cataract surgery using the Catalys Precision Laser System (Optimedica, Abbott Medical Optics). The IOL power was calculated using the Holladay 2 formula (Verion Image Guided System, Alcon Novartis) for all ranges of axial length. A target refraction of emmetropia using the IOL power corresponding to the myopic outcome closest to zero was selected.

For cases undergoing conventional phacoemulsification, the Verion Image Guided System was used intraoperatively to provide an overlay for the construction of a uniformly sized capsulorrhexis (5 mm). The single piece Tecnis Symfony IOL (Abbott Medical Optics, Inc.) was implanted in the capsular bag with a uniform anterior capsular rim overlap. A minimum time interval of 1 week was provided before the contralateral cataract procedure.

Postoperative protocol included loteprednol etabonate 0.5% topical suspension tapered over 6 weeks and moxifloxacin hydrochloride eye drops 0.5% four times/day for a week.

Tecnis Symfony intraocular lens

The Tecnis Symfony (ZXR00) is a single piece, ultraviolet filtering hydrophobic acrylic material. The anterior surface has a negative asphericity of -0.27 mm with a posterior 5.5 mm achromatic diffractive surface. The diffractive echelette surface is a proprietary pupil-independent design that creates an elongated focus without defined focal planes throughout. The IOL has a high Abbe number, thereby correcting chromatic aberration and providing high-contrast sensitivity.

Postoperative examination

The patients were examined at day one, 6 weeks, and 6 months postoperatively. A detailed dilated slit-lamp examination to ascertain IOL centration and capsulotomy overlap was carried out at every visit. Intraocular pressures were recorded using Goldmann Applanation Tonometer. Binocular and monocular uncorrected and best-corrected visual acuity (BDVA) (in spherical decimal equivalent [SDE]) were recorded for distance (uncorrected distance visual acuity [UDVA] and corrected distance visual acuity [CDVA]), intermediate at 70 cm (uncorrected intermediate visual acuity [UIVA] and corrected intermediate visual acuity), and near at 40 cm (uncorrected near visual acuity [UNVA] and corrected near visual acuity). Contrast sensitivity was evaluated for both mesopic and scotopic pupils (ETDRS Contrast, Aurochart, Aurolab, India).

A subjective questionnaire was administered to all the patients. Nondirected and directed questions regarding photic phenomena were raised. Symptoms of glare, starburst, and haloes were categorized as nil, mild, moderate, or severe. Need for spectacles as percentage of time during the day (0%, 25%, 50%, 75%, or 100%) was recorded for distance, intermediate, and near. Patients were asked to grade their level of satisfaction of vision for all distances, from least (score = 0) to most satisfied (score = 10). They were also questioned as to whether they would choose the same IOL again and recommend it to their family. The surgeon was questioned regarding the ease of handling and implantation of the IOL.

Statistical analysis

All data was recorded in Microsoft Excel worksheet. The analyses were performed using SPSS for windows software (Version 15.0, International Business Machine Corp.,).

Results

We conducted a prospective interventional case series including 100 eyes of 50 patients bilaterally implanted with the Tecnis Symfony IOL. All patients completed a follow up of 4-6 months. Table 1 summarizes the demographic and refractive data.

Visual outcomes and spectacle independence

At 4–6 months follow-up, the mean UDVA and CDVA was 0.89 ± 0.19 and 0.97 ± 0.23 , respectively. The mean UIVA and UNVA was 0.99 ± 0.13 and 0.99 ± 0.16 SDE, respectively, at similar follow-up points. The distribution of binocular vision for distance, intermediate, and near vision at 6 months' follow-up visit has been shown in Fig. 1.

Patients were questioned regarding their need for glasses for distance, intermediate, and near activities. At the 6-week follow-up visit, none of the patients required glasses for near or intermediate activities, whereas two patients required glasses for distance half of the time or more. At the 4–6 months' follow-up visit, one patient required glasses frequently for near and intermediate tasks, whereas two patients continued to use glasses regularly for distance vision (mean spherical equivalent -0.75 Diopters) [Fig. 2].

Optical or visual symptoms

Patients showed a high degree of satisfaction with visual quality. At 6 weeks' follow-up visit, only one patient complained of glare and haloes on nondirected questioning. On directed questioning, two patients had symptoms of moderate glare and one patient had symptoms of moderate halos. The remaining patients had no/minimal photic phenomena and were comfortable with night driving as well. The symptoms persisted for three of the four patients at 4–6 months' follow-up visit [Fig. 3].

Table 1: Patient demographics and refractive status

Variable	Result
Number of patients (<i>n</i>)	50
Mean age (years)±SD	59.84±11.68
Sex (%)	
Male	68
Female	32
Preoperative mean spherical equivalent (D)±SD	-0.24 ± 2.35
Postoperative mean spherical equivalent (D)±SD	-0.39 ± 0.4

SD: Standard deviation

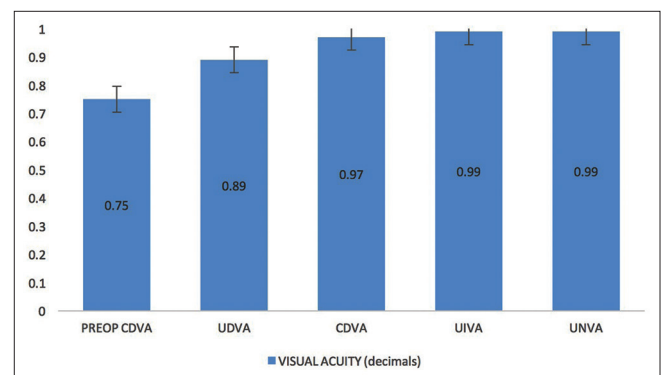


Figure 1: Distribution of best-corrected distance, intermediate, and near vision at 6 months' postoperative visit

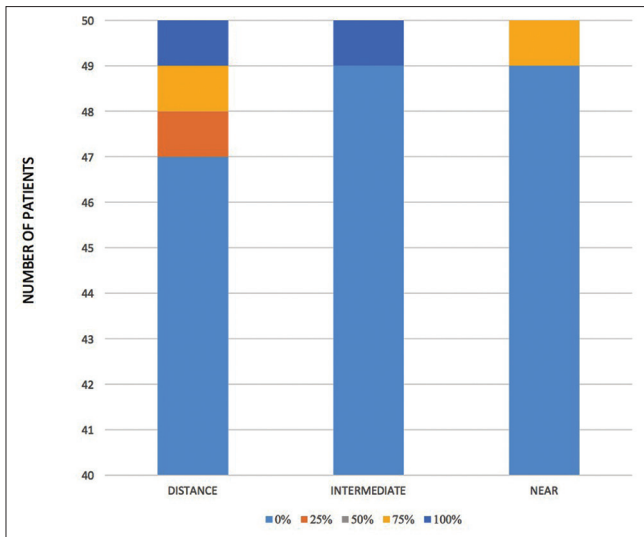


Figure 2: Need for spectacles (as percentage of time during the day) at 6 months' postoperative visit

Contrast sensitivity

Table 2 summarizes the contrast sensitivity (low and high contrast) for both scotopic and mesopic conditions at 6 weeks' postoperative visit.

Complications and/or adverse events

No postoperative complications were noted in any of the cases. There were no cases of IOL decentration or tilt over a 6-month follow-up. One eye required neodymium-doped yttrium aluminium garnet capsulotomy for a visually significant posterior capsular opacification (loss of two Snellen's lines of BDVA) at 4-months' postoperative visit.

Patient and surgeon satisfaction

The patients rated their satisfaction with their uncorrected visual outcomes on a scale of 0–10 (0 = not at all satisfied and 10 = very satisfied). The median patient satisfaction scores for distance, intermediate, and near vision were 9, 10, and 9, respectively. Ninety-six percent of the patients agreed to choosing the same IOL again and recommending it to their friends and family. Surgeon satisfaction over handling and implanting the IOL was high with a score of 10. The assessment of achievement of target refraction, visual performance, and overall satisfaction was 9.

Discussion

Cataract surgery is fast evolving into a refractive procedure with increased patient expectations for unaided distance and near vision alike. Diffractive multifocal IOLs provide two distinct foci for distance and near, with compromised intermediate visual acuity.^[5] Low add multifocal lenses may help in achieving superior unaided intermediate vision but may compromise near visual acuity.^[6] The Tecnis Symphony IOLs with its proprietary echelette design provides an elongated range of focus rather than individual focal points, resulting in potentially superior intermediate vision and reduced photic phenomena such as glare and halos.^[7]

Our results demonstrated a mean UDVA of 0.89 (SDE) at 6 months' postoperative visit. This was marginally lower than a UDVA of 0.94 achieved in the Concerto multicenter study.^[8] The

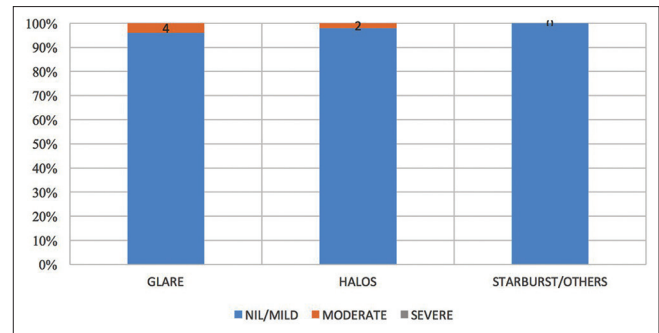


Figure 3: Photic phenomena at 6 months postoperative visit

Table 2: ETDRS contrast sensitivity at 6 week's postoperative visit

	Mean±SD (ETDRS)	Range (ETDRS)
Light on, high contrast	0.027±0.008	-0.1±0.26
Light off, high contrast	0.031±0.085	-0.1±0.26
Light on, low contrast	0.067±0.091	-0.1±0.3
Light off, low contrast	0.093±0.1	-0.1±0.4

SD: Standard deviation, ETDRS: Early treatment of diabetic retinopathy study

mean UIVA of 0.99 achieved in our study was superior to that achieved in multiple studies reporting their results with bifocal and trifocal IOLs.^[9-26] The mean binocular UNVA (at 40 cm) of 0.99 (LogMAR 0.01) reported in our study was similar to or superior to results obtained with apodized and bifocal diffractive IOLs.^[13-15,17-19] The UNVA was found to be consistent and patients did not show preference for either eye even if slight residual error was remaining. Law *et al.* reported a mean binocular UNVA of Log MAR 0.16 while using trifocal diffractive IOLs which combine bifocal and trifocal diffractive patterns.^[13] Alió *et al.* reported a mean monocular UNVA of 0.26 with a trifocal IOL.^[17] Chang *et al.* demonstrated a mean UDVA, UIVA, and UNVA of Log MAR 0.10, 0.43, and 0.18, respectively, using a diffractive multifocal IOL.^[27] Our study demonstrates superior visual outcomes as compared to other presbyopia-correcting IOLs.

In our study, superior visual outcomes were additionally associated with high levels of spectacle independence. The need for glasses was consistently low in the entire cohort. At 6-months' follow-up visit, one patient required glasses for near or intermediate activities and two patients required glasses for distance half the time or more. These results are similar to those achieved in a multicentric study using the same IOL, with slightly greater spectacle independence for near and intermediate vision.^[8]

At 6 weeks' postoperative visit, 92% of our patients experienced nil or mild photic phenomena while 98% of the patients did not complain of photopic phenomena on indirect questioning. At the 6 months' postoperative visit, only three patients experienced visually significant glare and halos which hampered daily activities and night driving. The incidence of disturbing photic phenomenon was minimal in our study as compared to the results published in earlier studies with other presbyopia-correcting IOLs. Visser *et al.* reported a 50% incidence of glare, halos, and starbursts in patients implanted with a toric diffractive multifocal IOL.^[28] Law *et al.* reported the results following implantation of a diffractive trifocal IOL, with an incidence of halos in 80%

of the patients at 1-month postoperative visit.^[13] Lubiński *et al.* reported a low level of halo perception in 75% of the patients while evaluating the results of a diffractive bifocal IOL.^[11] Chang *et al.* reported the results following implantation of a multifocal diffractive IOL.^[27] Seventy-eight percent, 26% and 48% of the patients reported postoperative halos, glare, and starburst, respectively. However, as the methods of questioning and measuring photic phenomenon are not standardized, a direct comparison cannot be made conclusively.

Overall patient satisfaction scores were encouraging with high subjective scores of 9, 10, and 9 for distance, intermediate, and near visual acuity, respectively. One hundred percent of the patients were highly satisfied with intermediate visual acuity and 96% of them agreed they would choose the same IOL again and would also recommend the lens to family and friends.

The Tecnis Symphony EROV IOLs demonstrate superior binocular uncorrected visual acuity for all distances. These results were associated with a high level of spectacle independence. In addition, the incidence of optical visual symptoms was within the typical incidence observed with monofocal IOLs. Satisfaction rates were high for both the patients and the surgeon.

Conclusion

The combined mechanism achieving an extended range of focus and achromatic design enables superior outcomes in comparison to diffractive multifocal IOLs.

Financial support and sponsorship

Dr. Ramamurthy Dandapani received study grant from Abbott Medical Optics during the duration of this study.

Conflicts of interest

There are no conflicts of interest.

References

- Calladine D, Evans JR, Shah S, Leyland M. Multifocal versus monofocal intraocular lenses after cataract extraction. *Cochrane Database Syst Rev* 2012;9:CD003169.
- Lane SS, Morris M, Nordan L, Packer M, Tarantino N, Wallace RB 3rd, *et al.* Multifocal intraocular lenses. *Ophthalmol Clin North Am* 2006;19:89-105.
- Łabuz G, Reus NJ, van den Berg TJ. Comparison of ocular straylight after implantation of multifocal intraocular lenses. *J Cataract Refract Surg* 2016;42:618-25.
- Pieh S, Lackner B, Hanselmayer G, Zöhner R, Sticker M, Weghaupt H, *et al.* Halo size under distance and near conditions in refractive multifocal intraocular lenses. *Br J Ophthalmol* 2001;85:816-21.
- Alba-Bueno F, Vega F, Millán MS. Halos and multifocal intraocular lenses: Origin and interpretation. *Arch Soc Esp Oftalmol* 2014;89:397-404.
- Rojas MJ, Yeu E. An update on new low add multifocal intraocular lenses. *Curr Opin Ophthalmol* 2016;27:292-7.
- Weeber HA, Meijer ST, Piers PA. Extending the range of vision using diffractive intraocular lens technology. *J Cataract Refract Surg* 2015;41:2746-54.
- Cochener B, Concerto Study Group. Clinical outcomes of a new extended range of vision intraocular lens: International multicenter concerto study. *J Cataract Refract Surg* 2016;42:1268-75.
- Kretz FT, Gerl M, Gerl R, Müller M, Auffarth GU, ZKB00 Study Group *et al.* Clinical evaluation of a new pupil independent diffractive multifocal intraocular lens with a +2.75 D near addition: A European multicentre study. *Br J Ophthalmol* 2015;99:1655-9.
- Cillino G, Casuccio A, Pasti M, Bono V, Mencucci R, Cillino S, *et al.* Working-age cataract patients: Visual results, reading performance, and quality of life with three diffractive multifocal intraocular lenses. *Ophthalmology* 2014;121:34-44.
- Lubiński W, Gronkowska-Serafin J, Podboraczyńska-Jodko K. Clinical outcomes after cataract surgery with implantation of the Tecnis ZMB00 multifocal intraocular lens. *Med Sci Monit* 2014;20:1220-6.
- Cochener B, Vryghem J, Rozot P, Lesieur G, Chevalier JP, Henry JM, *et al.* Clinical outcomes with a trifocal intraocular lens: A multicenter study. *J Refract Surg* 2014;30:762-8.
- Law EM, Aggarwal RK, Kasaby H. Clinical outcomes with a new trifocal intraocular lens. *Eur J Ophthalmol* 2014;24:501-8.
- Mojzis P, Peña-García P, Liehneova I, Ziak P, Alió JL. Outcomes of a new diffractive trifocal intraocular lens. *J Cataract Refract Surg* 2014;40:60-9.
- Mojzis P, Kukuckova L, Majerova K, Liehneova K, Piñero DP. Comparative analysis of the visual performance after cataract surgery with implantation of a bifocal or trifocal diffractive IOL. *J Refract Surg* 2014;30:666-72.
- Schmickler S, Bautista CP, Goes F, Shah S, Wolffsohn JS. Clinical evaluation of a multifocal aspheric diffractive intraocular lens. *Br J Ophthalmol* 2013;97:1560-4.
- Alió JL, Montalbán R, Peña-García P, Soria FA, Vega-Estrada A. Visual outcomes of a trifocal aspheric diffractive intraocular lens with microincision cataract surgery. *J Refract Surg* 2013;29:756-61.
- Sheppard AL, Shah S, Bhatt U, Bhogal G, Wolffsohn JS. Visual outcomes and subjective experience after bilateral implantation of a new diffractive trifocal intraocular lens. *J Cataract Refract Surg* 2013;39:343-9.
- Vryghem JC, Heireman S. Visual performance after the implantation of a new trifocal intraocular lens. *Clin Ophthalmol* 2013;7:1957-65.
- Ramón ML, Piñero DP, Pérez-Cambrodí RJ. Correlation of visual performance with quality of life and intraocular aberrometric profile in patients implanted with rotationally asymmetric multifocal IOLs. *J Refract Surg* 2012;28:93-9.
- Alió JL, Plaza-Puche AB, Piñero DP, Amparo F, Jiménez R, Rodríguez-Prats JL, *et al.* Optical analysis, reading performance, and quality-of-life evaluation after implantation of a diffractive multifocal intraocular lens. *J Cataract Refract Surg* 2011;37:27-37.
- Alió JL, Piñero DP, Plaza-Puche AB, Chan MJ. Visual outcomes and optical performance of a monofocal intraocular lens and a new-generation multifocal intraocular lens. *J Cataract Refract Surg* 2011;37:241-50.
- Alfonso JF, Puchades C, Fernández-Vega L, Montés-Micó R, Valcárcel B, Ferrer-Blasco T, *et al.* Visual acuity comparison of 2 models of bifocal aspheric intraocular lenses. *J Cataract Refract Surg* 2009;35:672-6.
- Kohnen T, Titke C, Böhm M. Trifocal intraocular lens implantation to treat visual demands in various distances following lens removal. *Am J Ophthalmol* 2016;161:71-7.
- Jonker SM, Bauer NJ, Makhotkina NY, Berendschot TT, van den Biggelaar FJ, Nuijts RM, *et al.* 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;41:1631-40.
- Alfonso JF, Fernández-Vega L, Baamonde MB, Montés-Micó R. Prospective visual evaluation of apodized diffractive intraocular lenses. *J Cataract Refract Surg* 2007;33:1235-43.
- Chang JS, Ng JC, Lau SY. Visual outcomes and patient satisfaction after presbyopic lens exchange with a diffractive multifocal intraocular lens. *J Refract Surg* 2012;28:468-74.
- Visser N, Nuijts RM, de Vries NE, Bauer NJ. Visual outcomes and patient satisfaction after cataract surgery with toric multifocal intraocular lens implantation. *J Cataract Refract Surg* 2011;37:2034-42.