Multifocal Intraocular Lenses: AcrySof IQ PanOptix Trifocal Lens

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20.1 Introduction

Trifocal IOLs were developed to solve the compromise of the intermediate vision provided by bifocal IOLs. The AcrySof PanOptix trifocal IOL (Alcon Surgical, Inc.) seeks low pupillary dependence and aims to improve intermediate vision with a substantial range and an optimal one at 60 cm, the distance most used recently in daily life with the massive development and rising usage of handheld devices and computers.

20.1.1 The AcrySof IQ PanOptix Trifocal IOL

This trifocal IOL is a single-piece biconvex design and is made with hydrophobic material. Its optical size is 6.0 mm, with an overall diameter of 13.0 mm. The optic is aspheric with a diffractive structure in the central 4.5 mm portion (15 diffractive zones) and an outer refractive zone to give three focal points for distance, intermediate and near vision (Fig. 20.1). The near addition of the AcrySof *IQ PanOptix* is +3.25 D for the near focus and + 2.17 D addition for the intermediate focus at the IOL plane [1–3].

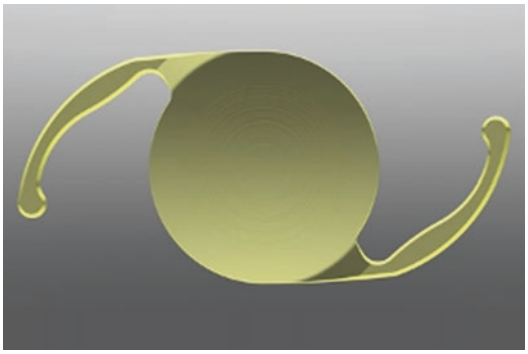

Fig. 20.1 A general view of the AcrySof IQ PanOptix IOL

20.1.2 Clinical Experience

20.1.2.1 Patients

Fifty-two eyes of 26 bilateral patients were included in this study with age ranging between 47 and 76 years. Patients analysed were candidates for cataract surgery and had no other active ocular diseases that might influence the visual outcome.

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20.1.2.2 Preoperative and Postoperative Examination

Preoperatively, all patients had a full ophthalmologic examination, including the evaluation of the refractive status, assessment of the distance and near visual acuities, slit lamp examination, tonometry and funduscopy. Other specific examinations were performed: corneal topography (Sirirus, Costruzione Strumenti Oftalmici) and biometry (IOL Master, Zeiss).

Postoperatively, patients were evaluated during 6 months after surgery. The postoperative examination protocol was identical to the preoperative protocol, with the measurement of the intermediate visual acuity at 80 cm, defocus curves, and contrast sensitivity with the Pelli-Robson test in photopic conditions; postoperative ocular aberrations were measured with the Osiris aberrometer; light distortion was evaluated using the light distortion analyser [4]; and the near activity visual questionnaire (NAVQ) was evaluated preoperatively and in the 3-month visit. The light distortion analyser is a device consisting of a central white light-emitting diode (LED) surrounded by 240 small, white LEDs distributed in 24 semimeridians. Peripheral stimuli (the smaller LEDs) are presented around the central source of light from the inner to the outer part of the test field. The test was performed first monocularly and then binocularly. The software calculates several indices that determine the size and regularity of the distortion surrounding the central source of light. The distortion index (DI) is calculated as the ratio of the area of points missed by the subject and the total area explored and is expressed as a percentage. The best-fit circle radius (BFCR) is defined as the circle that best fits the distortion area resulting from the linear binding of all points in each meridian of the device in millimetres. The deviation of the obtained polygonal shape from the best-fit circle fit is called the best-fit circle irregularity (BFCI) [4].

20.1.3 Results

20.1.3.1 Visual and Refractive Outcomes

Uncorrected (UDVA), corrected distance (CDVA) and uncorrected near (UNVA) visual acuities improved with the surgery ($p \leq 0.01$) and did not change during the follow-up ($p \leq 0.09$). Distance-corrected near visual acuity (DCNVA), uncorrected (UIVA) and distance corrected (DCIVA) intermediate visual acuities were stable during the follow-up ($p \geq 0.14$). These outcomes were in concordance with previous studies (Table 20.1) [1–3, 5–15].

20.1.3.2 Contrast Sensitivity Outcomes

Monocular and binocular contrast sensitivity at 3 months after surgery was 1.58 ± 0.18 and 1.86 ± 0.15 log units, respectively. These outcomes were similar that of other multifocal or monofocal IOLs [16, 17].

20.1.3.3 Defocus Curve

Defocus curve shows that this trifocal IOL provides a visual acuity equal to or better than 0.30LogMAR between defocus levels of +0.50 and −3.00D (Fig. 20.2). The defocus curve of this trifocal IOL is similar to that obtained with this type of IOL [2, 7, 9–14].

20.1.3.4 Optical Quality Outcomes

Figure 20.3 shows the internal aberrations at 5.0 mm of pupil obtained with a pyramidal aberrometer. Table 20.2 shows the light distortion indices. DI was reduced significantly when the measurement was done in binocular conditions ($p = 0.03$). Figure 20.4 shows an example of the measurement with the light distortion analyser. Distortion indices obtained with PanOptix IOL were lower than another trifocal IOL and higher than a monofocal IOL reported in a previous investigation [4].

Table 20.1 Table showing the preoperative and postoperative visual outcomes of patients implanted with the AcrySof IQ PanOptix trifocal IOL

Mean (SD) range	Preoperative	1 month	3 months	6 months	P value pre-1 month	P value 1–6 months
LogMAR UDVA	0.64 (0.53) 0.01 to 2.00	0.07 (0.11) −0.08 to 0.40	0.08 (0.12) −0.08 to 0.49	0.07 (0.10) −0.08 to 0.52	<0.01	0.09
Sphere (D)	+0.92 (2.54) −5.50 to +4.00	+0.22 (0.46) −0.75 to +1.50	+0.28 (0.46) −0.75 to +1.50	+0.29 (0.47) −0.50 to +2.00	0.04	0.71
Cylinder (D)	−0.50 (0.47) 0.00 to −2.00	−0.26 (0.32) −1.00 to 0.00	−0.30 (0.36) −1.00 to 0.00	−0.29 (0.32) −1.00 to 0.00	<0.01	0.15
LogMAR CDVA	0.07 (0.17) −0.08 to 0.70	0.01 (0.04) −0.08 to 0.21	0.02 (0.07) −0.08 to 0.30	0.01 (0.04) −0.08 to 0.22	0.02	0.09
LogMAR UNVA	0.62 (0.39) 0.00 to 1.40	0.17 (0.12) 0.00 to 0.40	0.18 (0.14) 0.00 to 0.70	0.16 (0.09) 0.00 to 0.30	<0.01	0.73
LogMAR DCNVA	–	0.13 (0.10) 0.00 to 0.30	0.13 (0.13) 0.00 to 0.62	0.13 (0.08) 0.00 to 0.30	–	0.82
LogMAR CNVA	0.12 (0.16) 0.00 to 0.70	0.07 (0.08) 0.00 to 0.30	0.09 (0.11) 0.00 to 0.52	0.08 (0.06) 0.00 to 0.30	0.24	0.34
LogMAR UIVA	–	0.12 (0.16) −0.30 to 0.49	0.13 (0.14) −0.08 to 0.52	0.12 (0.13) −0.08 to 0.52	–	0.64
LogMAR DCIVA	–	0.09 (0.13) −0.18 to 0.30	0.13 (0.15) −0.08 to 0.52	0.12 (0.12) −0.08 to 0.52	–	0.14
Addition	+2.45 (0.33) +1.50 to +2.75	+0.38 (0.44) 0.00 to +1.25	+0.38 (0.44) 0.00 to 1.25	+0.54 (0.63) 0.00 to +2.00	<0.01	0.18

*Abbreviations: *SD* standard deviation, *D* diopters, *UDVA* uncorrected distance visual acuity, *CDVA* corrected distance visual acuity, *UNVA* uncorrected near visual acuity, *CNVA* corrected near visual acuity, *UIVA* uncorrected intermediate visual acuity, *DCIVA* distance corrected intermediate visual acuity
From Alió et al. [14]

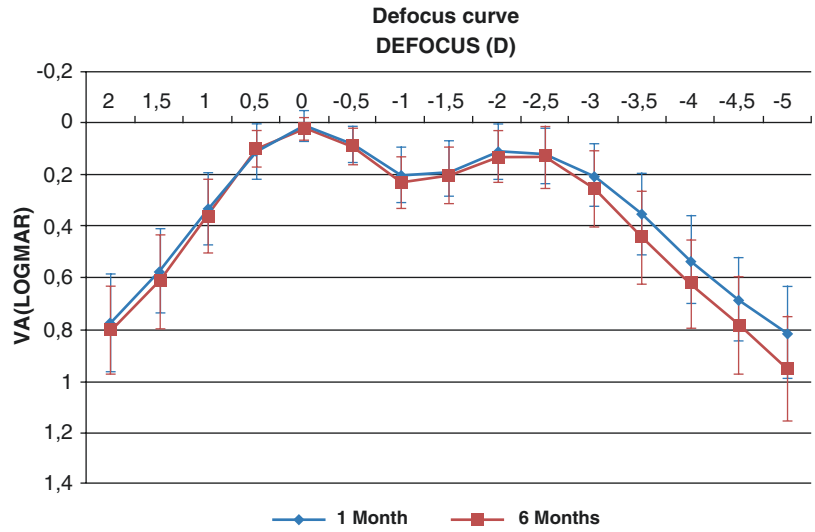

Fig. 20.2 Mean defocus curve of the AcrySof IQ PanOptix IOL. (From Alió et al. [14])

20.1.3.5 Near Activity Visual Questionnaire

The mean Rasch score of the NAVQ was 67.18 ± 20.64 and 20.21 ± 9.20 logits (0 = completely satisfied, 100 = completely unsatisfied) preoperatively and at 3 months after surgery, respectively ($p < 0.01$).

20.2 Conclusions

The AcrySof IQ Panoptix IOL is able to restore the visual function in far, intermediate and near distances after cataract surgery with acceptable contrast sensitivity. After implantation of this

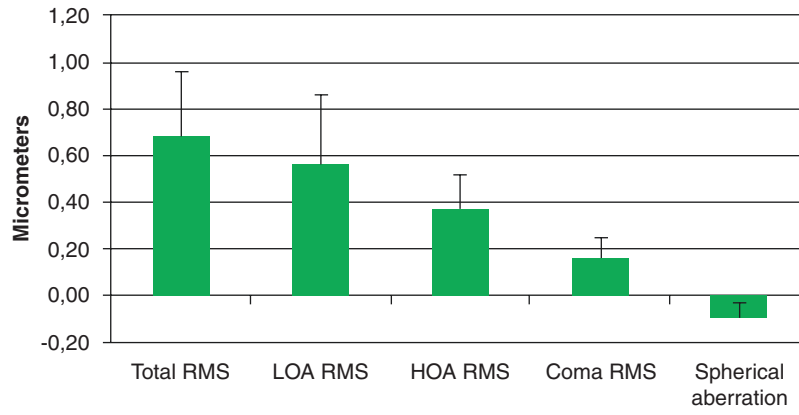

Fig. 20.3 Mean postoperative internal aberrometry measured by means of the KR-1 W aberrometer after implantation of the AcrySof IQ PanOptix IOL

Table 20.2 Mean values of light distortion analyser indices at 6 months after surgery

Parameter	Monocular mean (SD) range	Binocular mean (SD) range	P value
DI (%)	36.8 ± 18.5 17.98 to 81.65	23.81 ± 11.6 17.98 to 81.65	0.03
BFCR (mm)	47.11 ± 11.11 74 to 34.7	39.05 ± 9.24 56 to 26	0.05
BFCI (mm)	0.44 ± 0.32 1.22 to 0.06	0.20 ± 0.17 0.05 to 0.50	0.07

*Abbreviations: *SD* standard deviation, *DI* distortion index, *BFCR* best-fit circle radius, *BFCI* best-fit circle irregularity
From Alió et al. [14]

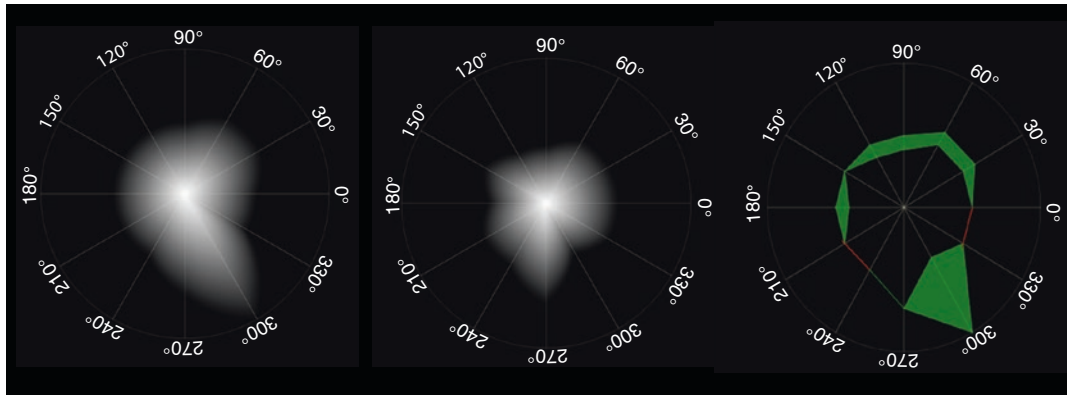

Fig. 20.4 Diagram of the light distortion analyser of one representative case. Left: monocular measurement. Middle: binocular measurement. Right: comparative between monocular and binocular measurement (monocular area, green and black zone, and binocular area, black zone). (From Alió et al. [14])

IOL, patients improve the quality of their near visual activity.

Advantages

- It restores the distance near and intermediate visual function after cataract surgery.
- It provides acceptable low mesopic contrast sensitivity function, better than other lenses from the Alcon Family.
- Patients improve the quality of their near visual activity with the surgery.

Disadvantages

- Distortion indices were higher than in a monofocal IOL.
- Near vision is insufficient in some cases, leading to the use of near vision spectacles.

Compliance with Ethical Requirements Ana B. Plaza-Puche and Jorge L. Alió declare that they have no conflict of interest. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study. No animal studies were carried out by the authors for this chapter.

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