Refractive lens exchange with the Array multifocal intraocular lens

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ABSTRACT

Purpose: To study the safety and efficacy of refractive lens exchange as a refractive surgery modality in the presbyopic population.

Setting: Oregon Eye Institute, Eugene, Oregon, USA.

Methods: This retrospective review of patient charts included patient selection, preoperative evaluation, management of astigmatism, surgical technique, postoperative visual outcome, and complications. The study included 68 eyes comprising 32 bilateral and 4 unilateral refractive lens exchanges.

Results: All patients having bilateral refractive lens exchange achieved an uncorrected binocular visual acuity of 20/40 and J5 or better 1 to 3 months postoperatively. More than 90% achieved an uncorrected binocular visual acuity of 20/30 and J4 and nearly 60%, of 20/25 and J3.

Conclusion: Refractive lens exchange was a safe and effective refractive surgery modality in presbyopic patients. *J Cataract Refract Surg 2002; 28:421–424 © 2002 ASCRS and ESCRS*

Refractive surgery options for people wishing to reduce or eliminate their dependence on spectacles or contact lenses have expanded rapidly in the past decade. Nevertheless, presbyopia remains one of the frontiers of refractive surgery.

For patients having cataract surgery, the Array® multifocal intraocular lens (IOL) (Allergan) offers reduced dependence on spectacles for both distance and near vision. Forty-one percent of patients receiving bilateral Array IOL implantation never require spectacles.[1] In particular, cataract patients receiving the Array achieve better uncorrected and distance corrected near visual acuity and report less limitation in visual function than those who receive monofocal IOLs.[2] In addition, the Array IOL provides a high level of uncorrected distance and near vision, reduced spectacle dependence, and high patient satisfaction.[3] Steinert et al.[3] found that 81% of patients with bilateral multifocal IOLs report comfortable near vision without glasses.

The optical side effects of the Array IOL are well known. Fifteen percent of patients have difficulty with halos at night, and 11% have difficulty with glare.[1] Despite these limitations, bilateral Array IOL implantation is a reasonable alternative for presbyopic patients who are motivated to reduce or eliminate dependence on spectacles.

We report our experience with refractive lens exchange with the Array multifocal IOL.

Patients and Methods

Patient Selection

The most suitable cataract patients for bilateral Array multifocal IOL implantation are those whose sur-

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gery is uneventful and whose personality is such that they are not likely to fixate on the presence of minor visual aberrations such as halos around lights. Patients presenting for refractive surgery may be considered in a similar light. Special caution may be indicated in refractive lens exchange candidates who have had previous keratorefractive surgery such as radial keratotomy or laser in situ keratomileusis, which can also produce visual aberrations. Caution may also be indicated in evaluating candidates who drive at night frequently or have high demands on vision and near work (eg, engineers, photographers, architects).

A positive response to 2 questions helps determine good candidates. First, "If we could put IOLs in your eyes that would allow you to see both distance and near without eyeglasses under most circumstances, would that be an advantage?" Second, "If that IOL is associated with halos around lights at night, would its placement still be an advantage?"[4] The answers to these questions demonstrate the candidate's degree of motivation and expectations. The motivated candidate with reasonable expectations should achieve a high level of satisfaction with refractive lens exchange in particular and with refractive surgery in general.

Preoperative Evaluation

Precise preoperative measurements and accurate IOL power calculation are critical to successful refractive lens exchange. The patients in this series had applanation axial length measurement and partial coherence interferometry with the IOLMaster (Zeiss). Corneal curvature was measured with an automated keratometer and the IOLMaster. The Holladay II formula was used for IOL power calculation because it takes into account disparities in axial length and anterior segment size. The addition of the variables of white-to-white corneal diameter and lens thickness helped predict the exact position of the IOL in the eye. The SRK T and SRK II formulas, as well as the Hoffer Q formula in shorter eyes, were used for comparative purposes.

Astigmatism Management

Spectacle independence with bilateral Array multifocal IOLs is enhanced by reduction in astigmatism. In this series, surgically induced astigmatism measured by vector analysis was taken into account in formulating the surgical plan. Preoperative astigmatism was measured with computerized corneal topography (EyeSys, Premier) and addressed by limbal relaxing incisions (LRIs) performed with a Force blade (Mastel Precision Surgical Instruments) as described by Gills[5] and Nichamin (L. Nichamin, MD, "Refining Astigmatic Keratotomy During Cataract Surgery," Ocular Surgery News, April 15, 1993).

In general, with-the-rule corneal astigmatism of +1.00 diopter (D) or greater and against-the-rule corneal astigmatism of +0.75 D or greater were considered appropriate for correction.

Surgical Technique

Each case was performed using topical anesthesia by 1 of 3 surgeons (I.H.F., M.P., R.S.H.). A temporal clear corneal incision 3.0 mm or less in width and 2.0 mm long was constructed with a Rhein 3 D diamond knife as previously described.[6] The capsulorhexis was sized to allow a small margin of anterior capsule to overlap the optic circumferentially to prevent anteroposterior alterations in location that would affect the final refractive status. Hydrodissection and hydrodelineation were done to facilitate lens disassembly and cortical cleanup. Meticulous removal of cortical matter was pursued to reduce posterior capsule opacification (PCO). Reduced effective phacoemulsification time was achieved to improve the rapidity and level of visual rehabilitation.[7]

Results

Sixty-eight eyes of 36 patients had refractive lens exchange with implantation of an Array multifocal IOL. Thirty-two patients had bilateral implantation. The mean age of the 15 women and 21 men was 58 years (range 45 to 81 years). The preoperative refractive sphere varied from –7.50 D to +6.50 D, and the preoperative refractive astigmatism varied up to 2.50 D. The preoperative spherical equivalent varied from –7.50 D to +7.37 D. Twenty-three eyes had LRIs to correct preoperative astigmatism.

In 70.6% of patients, the postoperative refractive sphere was within ±0.50 D of emmetropia. In 95.6% of patients, refractive astigmatism was 1.00 D or less. The postoperative refractive spherical equivalent was within ±0.25 D of emmetropia in 63.2% of patients and within ±0.50 D in 80.9%. The preoperative spherical

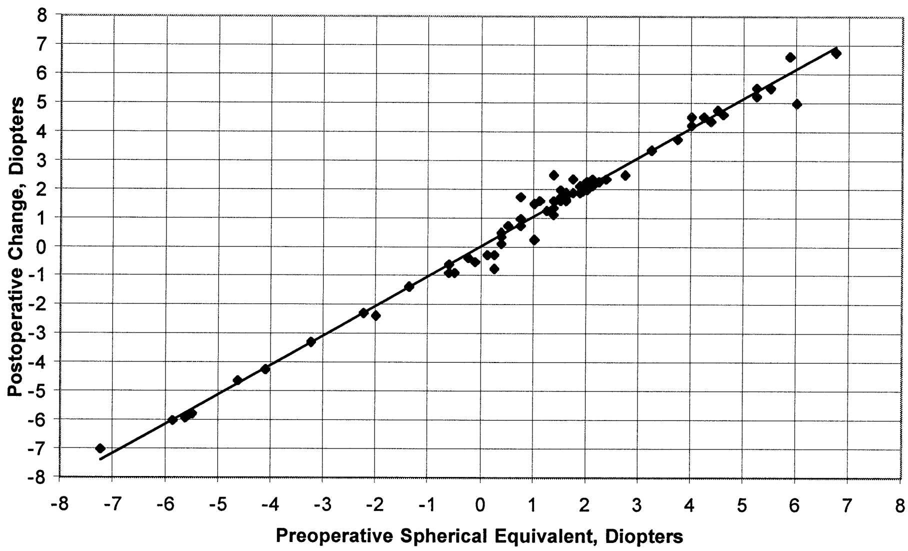

Figure 1. (Packer) Preoperative spherical equivalent compared to postoperative change in spherical equivalent. The linear regression line shows a high correlation between the intended correction and the achieved correction.

equivalent correlated highly with the amount of change in the postoperative spherical equivalent ($r = 0.993$) (Figure 1).

In 70.6% of patients, there was no change in best corrected visual acuity (BCVA) from preoperatively to postoperatively. Of the 13.2% of patients who lost 1 line of BCVA, 6 went from 20/15 to 20/20 and 3 from 20/20 to 20/25. In contrast, 16.2% of patients gained 1 or 2 lines of BCVA. Nine patients gained 1 line, 2 from 20/20 to 20/15, 5 from 20/25 to 20/20, and 2 from 20/30 to 20/25. Two patients gained 2 lines, 1 from 20/30 to 20/20 and 1 from 20/25 to 20/15.

In the 23 eyes having LRIs to correct astigmatism, the mean preoperative refractive (as opposed to corneal) astigmatism was 0.71 D (range 0.00 to 2.50 D). The mean postoperative refractive astigmatism was 0.32 D (range 0.00 to 1.25 D), a reduction of more than 50%. Twelve patients (52.2%) having LRIs had no postoperative refractive astigmatism.

Results of postoperative examinations at 3 and 6 months showed that 64 of 68 eyes achieved an uncorrected visual acuity (UCVA) of 20/40 and J5 or better (Figure 2). The remaining 4 eyes achieved 20/40 or better distance vision but J7 (2 eyes) and J8 (2 eyes) at near.

All patients with bilateral implantation achieved an uncorrected binocular visual acuity of 20/40 and J5 visual acuity (Figure 3). More than 90% achieved an uncorrected binocular visual acuity of 20/30 and J4 and nearly 60%, of 20/25 and J3.

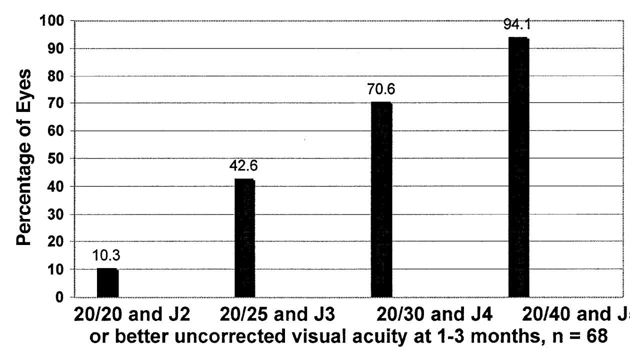

Figure 2. (Packer) Postoperative monocular visual acuity at distance and near.

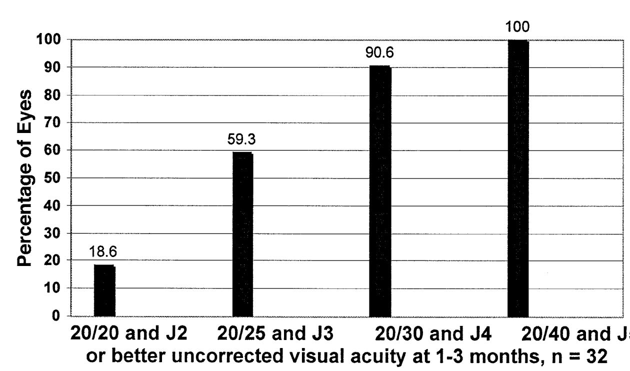

Figure 3. (Packer) Postoperative binocular visual acuity at distance and near.

Four eyes did not achieve J5 or better near vision without correction despite good uncorrected distance acuity; 2 eyes had 20/40, 1 had 20/30, and 1 had 20/20. The fellow eyes in these 4 patients had satisfactory near acuity, which improved the outcome for patients with bilateral IOL implantation.

One patient, a 66-year-old man with preoperative myopic astigmatism of –2.50 +2.25 × 110 in the right eye and –1.75 +2.25 × 60 in the left eye had excellent postoperative uncorrected distance acuity (20/20 both eyes) but reported difficulty with near vision. His near acuity was J7 in the right eye and J8 in the left eye. Examination revealed relatively miotic pupils in room illumination (2.0 mm both eyes); after instillation of phenylephrine 2.5%, near vision improved to J4. The patient was treated with argon laser photomydriasis.[8] The uncorrected near acuity subsequently improved to J4 in the right eye and J5 in the left eye, with a binocular uncorrected near acuity of J3. His uncorrected distance acuity remained 20/20 in both eyes. The patient returned 1 year later reporting halos around lights at night. Both pupils measured 4.5 mm in room illumination, and the uncorrected binocular visual acuity had dropped to 20/30 and J5. He was offered pilocarpine 0.5% to reduce the halos.

Four patients developed symptomatic PCO and had a neodymium:YAG (Nd:YAG) laser capsulotomy. One patient reported a "constant blur" despite the eye's UCVA of 20/20 and J4. After capsulotomy, he described his vision as "perfect." Another patient developed a reduction in near acuity to J8, which improved to J5 after an Nd:YAG laser capsulotomy.

One patient developed cystoid macular edema despite completely uneventful surgery. He was treated successfully with topical steroid and nonsteroidal solutions.

Discussion

Refractive lens exchange has become an important modality in our refractive armamentarium. The ability to read comfortably and see clearly in the distance without glasses has proven popular among patients. As one man with an uncorrected binocular acuity of 20/30 and J2 said, "It's great. Crossword puzzles are a snap." Our impression is that refractive lens exchange patients are among the happiest in our practice.

Achieving successful refractive lens exchange depends not only on patient selection, focusing on the patient's motivation and expectations, but also on unerring preoperative evaluation targeting accurate biometry and IOL power calculation. At present, as a tool for overcoming presbyopia as well as a variety of refractive errors, refractive lens exchange with the Array multifocal IOL produces excellent visual results. Unwanted photic phenomena, however, remain a challenge of multifocal technology.

References

1. Javitt JC, Wang F, Trentacost DJ, et al. Outcomes of cataract extraction with multifocal intraocular lens implantation; functional status and quality of life. Ophthalmology 1997; 104:589–599
2. Javitt JC, Steinert RF. Cataract extraction with multifocal intraocular lens implantation; a multinational clinical trial evaluating clinical, functional, and quality-of-life outcomes. Ophthalmology 2000; 107:2040–2048
3. Steinert RF, Aker BL, Trentacost DJ, et al. A prospective comparative study of the AMO ARRAY zonal-progressive multifocal silicone intraocular lens and a monofocal intraocular lens. Ophthalmology 1999; 106:1243–1255
4. Fine IH, Hoffman RS. AMO Array foldable silicone multifocal intraocular lens. Int Ophthalmol Clin 2000; 40(3):245–252
5. Gills JP, Gayton JL. Reducing pre-existing astigmatism. In: Gills JP, Fenzl R, Martin RG, eds, Cataract Surgery: the State of the Art. Thorofare, NJ, Slack, 1998; 53–66
6. Fine IH. Corneal tunnel incision with a temporal approach. In: Fine IH, Fichman RA, Grabow HB, eds, Clear Corneal Cataract Surgery and Topical Anesthesia. Thorofare, NJ, Slack, 1993; 5–26
7. Fine IH, Packer M, Hoffman RS. Use of power modulations in phacoemulsification; choo-choo chop and flip phacoemulsification. J Cataract Refract Surg 2001; 27: 188–197
8. Thomas JV. Pupilloplasty and photomydriasis. In: Belcher CD, Thomas JV, Simmons RJ, eds, Photocoagulation in Glaucoma and Anterior Segment Disease. Baltimore, MD, Williams & Wilkins, 1984; 150–157

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