THE ARRAY MULTIFOCAL INTRAOCULAR LENS: A NEW HORIZON

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SUMMARY

A retrospective review was conducted of 50 patients with bilateral Array multifocal intraocular lens implantation. The purpose was to assess their visual performance and adaptability to the visual world of multifocality. On binocular visual acuity examination all patients obtained, without any correction, Snellen 20/25 or more for distance and Snellen 20/40 (distant equivalent) or more for near. Contrast sensitivity for far and near was slightly reduced. Occasionally, 44% of the patients use spectacles especially for small print. All patients were very pleased with their functional vision without spectacles and in general had only minor problems with optical aberrations. Factors contributing to success and patient satisfaction are refractive cataract surgery and careful selection of patients through meticulous pre- and postoperative counselling on the new visual status.

RÉSUMÉ

Une étude rétrospective a été faite de 50 patients bilatéralement implantés avec une lentille intra-oculaire multifocale Array. Le but était d'établir la qualité de leur vue et leur capacité d'adaptation à la vision multifocale. Tous les patients obtenaient sans correction une vision de loin binoculaire d'au moins Snellen 20/25 et une vision de près d'au moins Snellen 20/40 (équivalent de loin). La sensibilité de contraste de loin et de près était légèrement diminuée. De temps en temps 44% des patients utilisent des lunettes,spécialement pour les petites lettres. Tous les patients étaient satisfaits avec leur nouvelle vision sans lunettes et en général se plaignaient peu des aberrations optiques. Le succès et la satisfaction des patients dépendent d'une chirurgie réfractive et d'une sélection méticuleuse des patients, leur expliquant les avantages et désavantages de la vision multifocale.

KEY-WORDS

Multifocality / Array / Refractive Surgery / Patient Selection and Counselling

MOTS-CLÉS

Multi-focalité / Array / Chirurgie Réfractive / Sélection de et Conseils aux Patients

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INTRODUCTION

Progress in cataract surgery, intraocular lens technology and lens power calculation during the last decade has substantially improved the visual outcome of pseudophakia. Multifocal Intra Ocular Lenses (''MIOL's'') have added a new dimension by creating the possibility of pseudoaccomodation.

The optical principles to correct presbyopia with spectacles involve alternating vision. Each different refractive portion of spectacle glasses creates a different focus. MIOL's on the contrary provide simultaneous vision, i.e. a simultaneous projection of in and out focus images of the same object on the retina. The combination of the simultaneous perception of in and out focus images presents the MIOL's with unique characteristics: on the one hand it has the benefit of providing pseudoaccomodation; on the other hand it causes some degree of contrast sensitivity loss and the perception of halos around bright images at night.

The experience of the author with MIOL's goes back to the late '80 when he started implanting Diffractive lens models. Due to its specific optics the Diffractive lens caused excessive problems of light scattering, glare and halos as a result of which the author discontinued using them. From '92 to '98, the author implanted several annular bifocal Storz True Vista lenses. The difficulty with these lenses was astigmatism control as the lenses had a plane PMMA optic requiring a 5,8 mm incision. The current preference of the author, since January '99, is to use the Array® zonal progressive MIOL (the ''Array''). The central 2 mm part of the optic of the Array creates distant vision and is surrounded by 4 aspherical zones of varying refractive power. Each zone creates repetitively near, intermediate and distant focal planes. With a pupil larger than 2 mm, approximately 50% of the available light energy forms the distant; 37% the near; and 13% the intermediate focus. As a result, the Array is a distant dominant multifocal lens. The Array is also a foldable lens allowing good astigmatism control.

MATERIAL AND METHODS

The author implanted 100 Array lenses bilaterally in 50 cataract patients with otherwise healthy eyes and with less than 2 diopters of preoperative astigmatism. All eyes included in this study had pupil diameters of more than 2 mm. when examined in a normally lighted examination room. The average age of the 12 men and the 38 women was 72 years (range 47-86). The minimal follow-up was 3 months.

In order to obtain reliable data, automatic keratometric readings were compared with handmade readings and contact ultrasound axial length measurements with immersion measurements. New technologies such as those offered by laser interferometry were not used but may help refine axial length measurements. The author started implanting the Array only after having build up extensive experience with the Allergan SI40 monofocal lens since the performance of the latter is similar to the Array in respect of the A constant. In this series of patients the author has used an A constant of 118.20. All patients underwent an uneventful phacoemulsification. A two step clear corneal incision of 2.8mm was made which afterwards was enlarged to 3mm for lens implantation with an injector. The corneal incision was either on the steepest axis or temporal with or without addition of peripheral arcuate corneal incisions. To provide optimal lens stability lens insertion was done through a 4mm capsulorrhexis.

In one eye, because of residual ametropia of more than 1 dioptre, there has been a lens exchange for another Array on the 7^{th} postoperative day. In an other eye, with a residual hyperopia of only 1 dioptre, the lens optic was brought in front of the capsulorhexis resulting in a hyperopic reduction of 0.75 dioptre.

RESULTS

On binocular examination, uncorrected distant visual acuity was very good, with 74% achieving Snellen 20/20 or more (fig. 1). Near visual acuity was lower. This was primarily due to the distance dominant optic of the Array, and the

Fig. 1:
Uncorrected Distance Visual Acuity
Following Bilateral ARRAY Implantation into 50 patients.

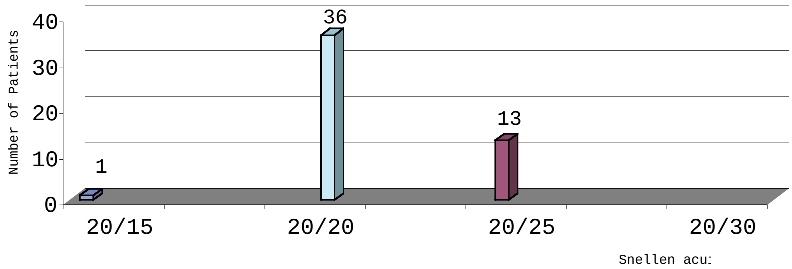
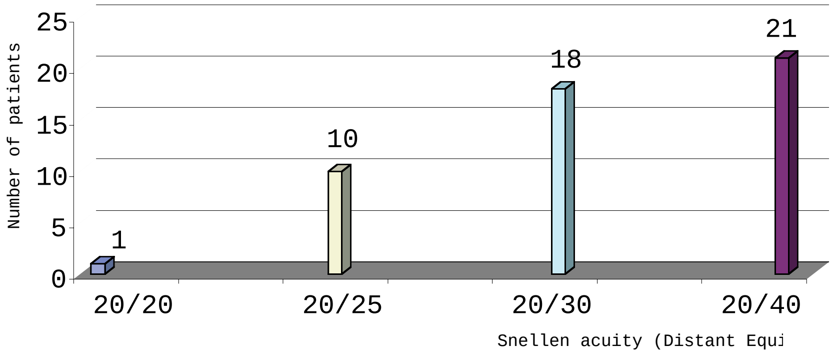


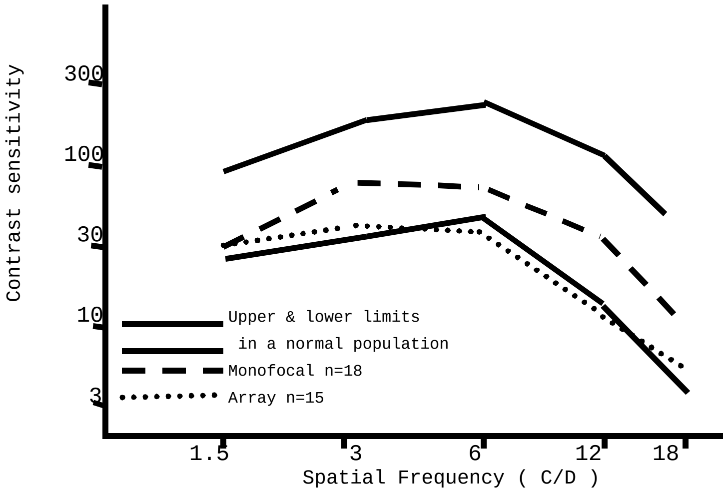
Fig. 2:
Uncorrected Near Visual Acuity
Following Bilateral ARRAY Implantation into 50 patients



target of the author to achieve emmetropia or slight hyperopia. All patients still achieved a binocular uncorrected visual acuity of Snellen 20/40 (distant equivalent) or better (fig. 2). Similar results of such distant and near visual acuities have been observed in several clinical studies (2) (5).

For a smaller group of patients with bilateral uncorrected best visual acuities for far and near, contrast sensitivity was evaluated in a normally lighted examination room.For distance the Vistech Consultants,Inc. Vision Contrast Test System(VCTS®) was used and for near the 12.5% contrast charts of the Holladay Contrast Acuity Test (C.A.T.®). As reported in the literature (3) (4), when using multifocal lenses compared to monofocal lenses, the author observed some general reduction in detail discrimination due to a loss of contrast. Indeed, when measuring the average contrast sensitivity for distance in a group of 15 bilateral Array lens implant patients with a binocular uncorrected visual acuity of 20/20, contrast sensitivity was lower compared to that of a group of 18 bilateral monofocal lens implant patients of similar age with similar binocular visual acuity. However, contrast sensitivity for distance with the Array, remained predominantly within the reference range. (fig.3). When measured for near under very low contrast conditions with the Holladay 12.5% contrast charts, visual acuity dropped to 20/80 (distant equivalent) or less in a group of 10 bilateral Array lens implant patients with a binocular uncorrected near visual acuity of Jaeger 1 (20/25 distant equivalent) compared to the visual acuity of 20/60(distant equivalent) or better in a group of 10 bilateral monofocal lens implant patients of similar age and with a similar for near corrected visual acuity. However, the slight reduction in contrast sensitivity did not affect the patients' general visual satisfaction. When asked about their functional vision, patients reported that distant vision was very good, near vision good, and intermediate vision moderate to good. Above all, the patients valued their ability to see clearly in all directions across a range of distances from

Fig. 3: Mean Distance Contrast Sensitivity in Patients with UCVA of 20/20



near to far. Occasionally, 44% of patients used spectacles,in particular for reading or sewing. However, this was generally not felt as a failure by properly informed patients.

Furthermore, when asked to grade the extent of visual difficulty as a result of optical aberrations at night, the vast majority of the patients reported only minor inconveniences. Nobody, on condition of exact emmetropic correction, complained about insurmountable hindrance for night time driving. In all cases there was a visual improvement over time.

DISCUSSION

A combination of surgical strategies, patient selection, education and counselling is required in order to obtain good results with the Array.

Surgical strategies include first of all precise lens power calculation. It is both critical and one of the most important factors to enter the happiness zone of emmetropia which is the best guarantee for optimal visual performance. A slight postoperative myopic refraction of e.g. minus 0.75 dioptre would favour near vision. However, due to the more forward location of the optical planes and the subsequent larger blur on the retina,optical side effects such as halos around light sources would become more prominent. On the contrary, a slight postoperative hyperopic refraction, would make halos around lights almost completely disappear but near vision would be compromised. Therefore, in order to target emmetropia one has to consider the accuracy of keratometric readings and axial length measurements, the personalizing of A constants and the use of different formulas or computer software to calculate the IOL power. Furthermore bilateral emmetropia with Array lenses guarantees not only optimal visual acuity at distance and good visual acuity at near but also full stereopsis at distance and at near. Therefore, in my opinion, this provides a superior quality of vision compared to techniques for obtaining pseudoaccomodation with monofocal implant lenses through unilateral myopia or planned myopic astigmatism (1) which results in poorer visual acuities at distance and monovision.

Other critical surgical strategies include management of astigmatism to a level of less than 0.75 dioptre and lens insertion through a 4 mm capsulorhexis. The latter provides optimal lens stability and therefore prevents any forwards displacement of the lens causing a myopic shift in refraction or any tilt and decentration due to capsular fibrosis.

Equally important as a good surgical strategy is the time one spends in selection, education and counselling of candidate patients.

Patients need to be informed on the pros and cons of simultaneous vision. There are interesting video films available on this subject from Ohnuma of the Chiba University (Japan) and K.Waltz MD of Indiana (USA). These films inform candidate patients which kind of advantages and optical side effects they should expect with the Array. One should also carefully explain certain particular new visual situations resulting from pupil size and lens design. As an example, reading with the Array is easier with low to medium light than in full bright sunlight and contrastfull letters are less comfortable for reading than paperback print.

Further, patients need to understand that adapting to this new visual world is based on a learning process during which, thanks to the complex system of image processing in the visual cortex, the quality of the images will improve and the optical side effects diminish. The author observed that younger patients adapted more readily to this new visual environment.

Finally, patients need to have reasonable expectations. Multifocality means a reduction of spectacle dependency, not complete elimination of glasses.

CONCLUSION

Based on an experience of nearly two years, the author came to the conclusion that the profile of the ''ideal'' Array candidate is a patient

- with an active lifestyle and a positive mind(=relatively younger age group);
- who is preoperatively hyperopic and has healthy eyes;
- with a very strong desire to be less dependent on spectacles;
- needing bilateral implantation; and
- with low night time driving demands.

Although the ophthalmologic community seems to be reluctant to use MIOL's, the author is convinced that for a very large range of daily activities the specific features of the Array MIOL permit the well trained surgeon to offer properly selected patients the freedom of multifocality without spectacles.

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