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MULTIFOCAL INTRAOCULAR LENSES TO CORRECT PRESBYOPIA AFTER CATARACT SURGERY

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SUMMARY – Monofocal intraocular lenses are effective in improving vision after cataract surgery but the loss of accommodation is not restored by implantation of these intraocular lenses. Because multifocal intraocular lenses may improve uncorrected distance and near vision, we compared clinical outcome and patient satisfaction after implantation of multifocal intraocular lenses. The study included eight patients who underwent cataract surgery using phacoemulsification and implantation of multifocal intraocular lenses (ReStor,Tecnis). Intraocular power calculation was measured by standard immersion A-scan ultrasonography using Holladay 2 formula, with target hyperopia +0.50 Dpt. Assessments were made preoperatively, and at 1 and 3 months postoperatively, whereas outcome was evaluated by interview. Satisfaction related to preoperative expectations was similar in all study patients. Visual acuity was 0.9-1.0 in 92% of the patients. All patients were satisfied with near vision without glasses. The perceived quality of corrected near vision showed highest correlation with patient satisfaction. Study results suggested that the patients were satisfied with their intraocular lens performance, and most would have the multifocal intraocular lens implanted again. The frequency of spectacle wear was greatly reduced for both distance and near vision.

Key words: *multifocal intraocular lenses, presbyopia, cataract surgery*

Introduction

Presbyopia is a gradual, age-related loss of accommodation. Unlike other refractive errors, presbyopia affects everyone at the same point in his/her life time[1,2]. Spectacle correction, monovision, corneal myopic astigmatism, and recently new intraocular lens (IOL) designs are considered alternatives to re-establish unaided near vision[3-5]. Despite excellent restoration of visual acuity, patients remain presbyopic after cataract surgery. Cataract surgery techniques and IOL designs have lately improved to provide the best quality of vision in pseudophakic patients, attempting to mimic the presbyopic crystalline lens[6]. Monofocal IOLs require surgeons to correct either distance or near vision. Multifocal IOLs address this limitation using the principle of simultaneous vision[7]. Incoming light is divided between two lens powers, one for distance vision and one for near vision. The distance of the user from the object determines the predominating power. When one views a distant object the image from the near power is greatly defocused and very faint, so only the object in the distance is seen. Likewise, when one views a near object the image produced by the distance power is greatly defocused and faint. Clinically, multifocal IOLs have been reported to provide patients with functional near and distance vision with acceptable satisfaction[8-15]. Reduced image contrast and unwanted visual phenomena including glare and halos have also been associated with multifocal IOL performance[8-12,16-21].

The AcrySof diffractive IOL (ReStor) is a posterior chamber lens developed by Alcon Research, Ltd. (Fort Worth, TX, USA). The lens has biconvex optic that contains a diffractive structure in the central 3.6 mm on the anterior surface of the optic and divides light between two foci. Tecnis is also a diffractive IOL developed by Advanced Medical Optics (AMO) (Santa Ana, CA, USA). The lens has modified anterior surface de-

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signed to address spherical aberration and improve functional vision.

Patients and Methods

Eight patients treated at University Department of Ophthalmology, Sestre milosrdnice University Hospital, were enrolled in the study. Four patients were assigned to the ReStor group and Tecnis group each. Preoperative considerations were as follows: patients who no longer desire to wear glasses, age, functional and occupational requirements, degree of general alertness, ocular pathology, patient visual demands, expectation for near vision needs, qualified for bilateral implants. Preoperative exclusion criteria were: subjective exclusion-hypercritical patients, patients with unrealistic expectations, those who wanted to wear glasses, and occupational night driving. Medical exclusion criteria were: >1.0 D of corneal astigmatism, pre-existing ocular pathology, previous refractive patients, and individuals with monofocal lens. Intraoperative exclusion criteria were: significant vitreous loss, pupil trauma, factors that impact long-term IOL performance, zonular damage, capsulorrhexis tear/rupture, and capsular rupture. Successful IOL power calculations are extremely important because various small errors result in a large error. Keratometry was performed manually. Immersion ultrasound biometry was performed in all patients by an experienced examiner using Holladay 2 or SRK-T formulas. All patients were operated on by phacoemulsification and implantation of multifocal intraocular lenses. The following parameters were postoperatively assessed: visual acuity (distance and near), quality of life (questionnaire), self-reported rating of satisfaction (questionnaire), visual phenomena, and frequency of spectacle wear. Patients were asked to complete a questionnaire on days 30, 60 and 90 postoperatively, and to identify and rate the effects of various issues. The questionnaire also allowed subjects to rate the level of satisfaction with their vision as well as the impact visual performance on their lifestyle. The follow up period was 3 months.

Table 1. Visual acuity (best and uncorrected; all patients achieved clear distance 0.7 or better and near vision)

Visual acuity (90 days postoperatively)		
Distance	0.7-0.8	0.9-1.0
UCVA	2/8	6/8
BCVA	8/8	8/8
Near	Standard	Best
Uncorrected	7/8	1/8
Best corrected	8/8	8/8

Table 2. Visual phenomena (90 days postoperatively)

	No or mild	Moderate	Severe
Glare	4	3	1
Halos	4	3	1
Night vision	6	1	1
Color perception	7	1	0
Disorder near and far	6	2	0
Blurred near and far	7	1	0
Double vision	7	1	0

Results

We analyzed 8 eyes operated by the same surgeon at our Department between October 2005 and February 2006. The mean age of our patients was 65 (range 58-72) years. Preoperative visual acuity was 0.0125-0.5 (in both groups). Postoperatively, six patients had uncorrected visual acuity (UCVA) for distance 0.9-1.0 and all eight patients had best corrected visual acuity (BCVA). UCVA standard for near vision was recorded in seven and BCVA in 8 patients. Visual acuity is presented in Table 1. Postoperative visual acuity was the same in the two groups. All patients achieved clear distance 0.7 or better and near vision.

The questionnaires allowed patients to indicate whether they would have chosen the same lens model implanted again. Seven of eight patients would have the same lens implanted again after the second eye implant. Visual phenomena of no or mild glare, halos, problems with night vision, problems with color perception, distorted near and far vision, blurred near and far vision, and double vision were present in most patients. Only three patients had severe visual phenomena (Table 2).

The frequency of spectacle wear was measured at a 3-point categorical scale: never, sometimes and most of the time. Postoperatively, wearing glasses for distance

Table 3. Spectacle dependence (90 days postoperatively)

	Distance	Near
	Never	6 7
Sometimes	1	1
Most of the time	1	1
All the time	0	0

vision was needed in six, and for near vision in seven patients. Spectacle dependence is presented in Table 3.

Discussion

Multifocal IOLs are designed to provide functional distance and near vision after cataract surgery. As basically two different types of multifocal technology exist (diffractive and refractive), the difference between these lenses is discussed. A theoretical study on model eyes showed that diffractive multifocal IOLs are superior to refractive multifocal IOLs for near vision, whereas for distance vision they are comparable[22]. When evaluating multifocal IOLs, intermediate vision also needs to be evaluated. A study by Weghaupt *et al*.[23] has shown that results for distance and near visual acuity are very satisfactory with a diffractive multifocal IOL, whereas for intermediate distance visual acuity may be limited to activities that do not require optimal vision. Reading is one of the most important near vision activities preformed by humans. Good performance on a static reading chart cannot simulate the real performance of an IOL. The advent of new IOL models such as this diffractive IOL may help patients reduce their dependence on spectacles for distance and near reading. Several quality of life studies report a high level of satisfaction among patients implanted with diffractive or refractive IOLs because of their improved reading ability. This study demonstrated that all our patients could read without glasses compared with other studies reported in the literature[24-27]. In those studies, 60%-80% of patients could read without glasses. These studies were performed in great patient populations, so they cannot be compared with our study that included a small number of patients.

Conclusion

Our study results showed that patients were satisfied with their IOL performance, and most would have multifocal IOLs implanted again. The frequency of spectacle wear was greatly reduced for both distance and near vision, with patients having rated their vision without spectacles to be noticeably better after each successive surgery. These findings suggest that multifocal IOLs can improve the quality of life in active patients who wish to reduce their dependence on glasses. This technology offers surgeons a feasible way of meeting patient's expectations of an improved lifestyle as the result of reduced spectacle dependence.

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Sažetak

MULTIFOKALNE INTRAOKULARNE LEĆE ZA KOREKCIJU PREZBIOPIJE NAKON OPERACIJE KATARAKTE

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Monofokalne intraokularne leće su učinkovite u poboljšanju vidne oštrine nakon operacije katarakte, ali se gubitak akomodacije ne može vratiti ugrađivanjem ovih leća. Budući da multifokalne intraokularne leće poboljšavaju vidnu oštrinu na daljinu i blizinu, usporedili smo kliničke rezultate i zadovoljstvo bolesnika nakon ugradnje multifokalnih intraokularnih leća. U istraživanje je bilo uključeno osmoro bolesnika operiranih metodom fakoemulzifikacije, kod kojih je ugrađena multifokalna intraokularna leća (ReStor, Tecnis). Aksijalna duljina je mjerena imerzijskom tehnikom *A-scan* uz primjenu formule Holladay 2, a željena poslijeoperacijska refrakcija je bila do +0,50 Dpt. Bolesnici su pregledani prijeoperacijski, te 1. i 3. mjeseca poslijeoperacijski, uključujući intervjue. Zadovoljstvo u odnosu na prijeoperacijska očekivanja bilo je slično kod svih bolesnika. Vidna oštrina bez korekcije bila je 0.9-1.0 kod 92% bolesnika i nisu bile potrebne dodatne korekcije na blizinu. Zabilježena kvaliteta vida na blizu kod bolesnika s multifokalnom intraokularnom lećom bila je usko povezana sa zadovoljstvom nakon operacije katarakte. Ova studija je pokazala izrazito zadovoljstvo bolesnika s multifokalnom intraokularnom lećom, te bi oni opet izabrali istu kod ponovne operacije katarakte. Potreba za nošenjem korekcije za daljinu i blizinu je smanjena.

Ključne riječi: *multifokalne intraokularne leće, fakoemulzifikacija, katarakta*