OUTCOME AFTER MULTIFOCAL INTRAOCULAR LENS EXCHANGE BECAUSE OF SEVERELY IMPAIRED QUALITY OF VISION

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ABSTRACT

Purpose: To evaluate the surgical outcome after intraocular lens exchange in patients implanted with a multifocal intraocular lens (MIOL) who presented impairing visual complaints
Setting: Department of Ophthalmology, Antwerp University Hospital, Belgium.
Methods: 25 eyes of 17 consecutive patients underwent IOL exchange. Pre- and postoperative evaluation consisted of: determining patient's complaints, type of IOL before and after IOL exchange, degree of glare and aberrometry (mainly preoperative data), pre and postoperative DCVA and NCVA.
Results: Diffractive MIOL were more frequently exchanged than refractive MIOLs and were exchanged when possible by a bag-in-lens IOL. DCVA, NCVA and postoperative subjective complaints improved significantly postoperatively. Eyes with prior Nd:YAG laser capsulotomy needed anterior vitrectomy during MIOL exchange procedure due to the presence of a ruptured anterior vitreous face by the laser treatment.
Conclusion: MIOL exchange can be performed safely and with very good visual outcome in patients with severe postoperative visual complaints related to decentered MIOL. Although, patient's postoperative quality of vision remained poor in 7 eyes out of the 25 in this series.

KEYWORDS

IOL exchange, multifocal IOL exchange, multifocal IOL complications

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INTRODUCTION

Because the unaided near vision after implantation of a multifocal intraocular lens (MIOL) is superior to that of a monofocal IOL,(1,2,3,4) MIOLs recently became a popular alternative for monofocal IOLs in patients seeking spectacle independence after cataract surgery or after refractive lens extraction. However MIOLs are known to cause adverse effects, such as reduced contrast sensitivity, increased visual aberrations, halos and reduction of visual acuity (1,3). Many of these complaints can be related to improper IOL centration, which in the case of complex optics, such as multifocal IOLs, is of the utmost importance (5,6,7). While most of these complaints can be managed conservatively (i.e. by spectacles, contact lenses, eye drops or laser treatment), 7% of these patients ultimately require an IOL exchange, (1) mostly due to adverse effects inherent to the MIOL design (glare and aberrations), miscalculation of the lens power or postoperative decentration or tilt of the MIOL (2).
With the increasing popularity of MIOLs over the past years, the number of MIOL exchanges has increased considerably (2). It is therefore essential that comprehensive exclusion criteria be formulated and that a proper preoperative assessment is performed allowing to determining the correct surgical technique for each patient. Special attention must be given to higher order aberrations, which depend strongly on pupil size and IOL type and may change drastically in case of IOL decentration or tilt (8).
This work aims to give a clinical report of the changes that were found after MIOL exchange in a series of patients with impaired vision following MIOL implantation. Special attention is given to refraction, visual acuity, glare and wavefront aberrations.

PATIENTS AND METHODS

Patients

All patients included in this study had complaints of severely impaired vision after implantation with a MIOL during an otherwise uneventful cataract procedure in the period between September 2005 and July 2010. These complaints included diplopia, blurred vision, glare, halos (causes inability for night driving), loss of contrast sensitivity (expressed subjectively by the need of more light during reading and blurred far vision) and photophobia in such degree that IOL exchange was deemed to be the only solution.

Preoperative examinations included distance corrected visual acuity (DCVA; in decimal notation), near corrected visual acuity (NCVA; in decimal notation) (9) , glare test (C-Quant straylight meter, Oculus Optikgeräte, Wetzlar, Germany) and aberrometry (iTrace Visual Function Analyzer, Tracey Technologies, Houston, TX) expressed in root-mean-square (RMS). Fundus examination and if necessary SOCT were performed. These preoperative examinations were repeated at 6 months or 1 year postoperatively depending on the persistence of patient's subjective complaints.
IOL calculation of the secondary IOL was performed using the SRK/T-formula (10) based on biometry performed with the IOL Master Optical biometer (V.2.02, Carl Zeiss, Jena, Germany) or, if unsuccessful, by an ultrasound biometer (Digital biometric ruler Pacscan 300A, Sonomed, Lake Success, NY).

IOL exchange procedure

IOL exchange was performed by one and the same surgeon (M-J T) for all eyes. Depending on their preferences, the patients were operated either under topical anesthesia (benoxinate hydrochloride 0.4% eye drops and intracameral injection of lidocaine hydrochloride 0.2%) or under general anesthesia. A temporal sclerocorneal incision of 2.8 mm was made, followed by the injection of a 1/1000 diluted solution of adrenalin in balanced salt solution. Next, the anterior chamber was filled with a long-molecular-chain ophthalmic viscosurgical device (OVD; sodium hyaluronate 1.4%, Healon GV, AMO). After viscodissection and peeling of fibrotic tissue on the capsule (11,12,13,14), the MIOL was mobilized in the capsular bag, and removed from the eye in one or more pieces (15,16,17). Vitreum prolapse occurred commonly in eyes that underwent Nd:YAG laser capsulotomy, in which case an-

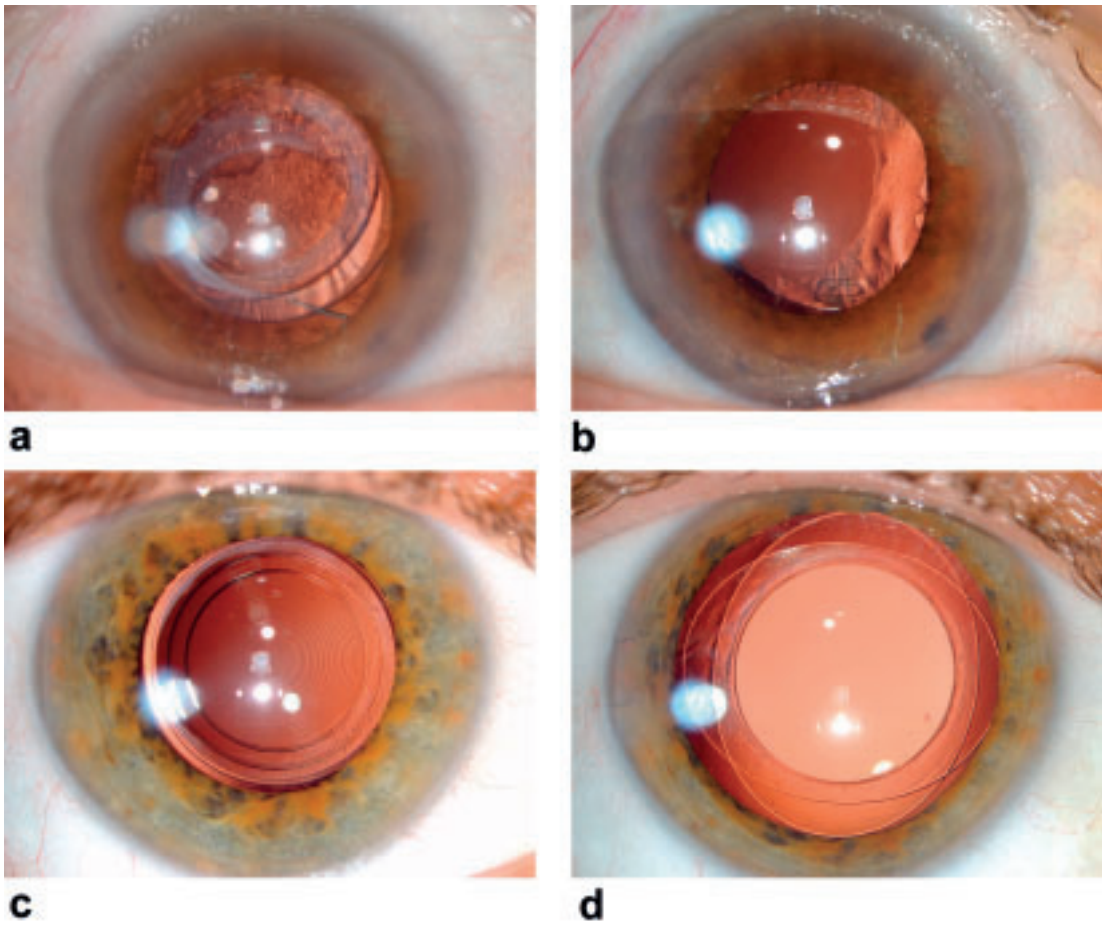

Fig. 1: (a,c) Preoperative slit lamp pictures of patients #13 and #12. (b,d) Postoperative slit lamp pictures of patient #13 after sulcular IOL implantation and #12 after bag-in-the-lens implantation

terior vitrectomy with a 23G vitrectomy probe (Alcon) was performed. Finally a monofocal IOL was implanted and, depending on the wound stability, the eyes were closed by corneal hydration or by suturing. *Figure 1* shows the pre and postoperative anterior segment pictures of two different cases (C after postoperative sulcular IOL implantation and D after postoperative bag-in-the-lens implantation).

Postoperative treatment consisted of the following regimen: topical tobramycine, dexamethasone and non-steroidal anti-inflammatory (NSAID) eye drops, 4 times a day for one week. The NSAID eye drops were stopped at week 4 or earlier depending on the inflammation status of the eye.

Statistical evaluation

Data were analyzed using SPSS for windows (version 19, IBM SPSS Inc) using a paired-samples Student *t* test. A *P*-value less than 0.05 is considered statistically significant.

RESULTS

All patient and lens details are given in *Table 1*. This study includes 25 eyes of 17 patients of which 4 (24%) were male and 13 (76%) were

Table 1: *Patient data (25 eyes of 17 patients)*

			MIOL to be exchanged					Replacing IOL	
Nr	**Sex**	**Age (y)**	**Eye**	**IOL type**	**D/R**	**YAG**	**T**	**IOL positioning**	**IOL type**
1	F	69	R	Alcon AcrySof Restor	D	N	6	LIB	Alcon Acrysof SA60AT
	F	69	L	Alcon AcrySof Restor	D	N	11	BIL	Morcher 89A
2	F	62	R	Alcon AcrySof Restor	D	Y	27	BIL	Morcher 89A
	F	62	L	Alcon AcrySof Restor	D	Y	26	BIL	Morcher 89A
3	F	75	L	Alcon AcrySof Restor	D	N	7	BIL	Morcher 89A
4	F	64	L	Alcon AcrySof Restor	D	N	13	Sulcular	Alcon Acrysof MA30AC
5	F	76	L	Alcon AcrySof Restor	D	Y	16	BIL	Morcher 89A
6	F	61	R	Alcon AcrySof Restor	D	N	22	BIL	Morcher 89A
7	F	75	R	Alcon AcrySof Restor	D	N	18	BIL	Morcher 89A
	F	75	L	Alcon AcrySof Restor	D	N	10	BIL	Morcher 89A
8	M	61	L	Alcon AcrySof Restor	D	N	30	BIL + Sulcular add	Morcher 89A + Rayner Sulcoflex
9	M	56	L	AMO Array	R	Y	23	Sulcular	Alcon Acrysof SA60AT
10	F	76	L	3M style 815	D	Y	216	Iris fixated	Ophtec Artisan Afakia
11	F	70	R	3M style 825	D	Y	191	Iris fixated	Ophtec Artisan Afakia
12	F	44	R	AcryTec Acri.Twin	D	N	10	BIL	Morcher 89A
	F	44	L	AcryTec Acri.Twin	D	N	8	BIL	Morcher 89A
13	F	74	R	AcryTec Acri.Twin	D	Y	20	Sulcular	Z9000 Pharmacia
	F	76	L	AcryTec Acri.Twin	D	N	38	BIL	Morcher 89A
14	M	60	R	AcryTec Acri.LISA	D	N	24	BIL	Morcher 89A
	M	60	L	AcryTec Acri.LISA	D	N	23	BIL	Morcher 89A
15	F	70	R	AcryTec Acri.LISA	D	N	5	BIL	Morcher 89A
	F	58	L	AMO Tecnis	D	N	2	BIL	Morcher 89A
16	F	58	R	AMO Tecnis	D	N	4	Sulcular	Alcon Acrysof SA60AT
17	M	57	R	AMO Rezoom	R	N	17	BIL	Morcher 89A
	M	57	L	AMO Rezoom	R	N	18	BIL + Sulcular add	Morcher 89A + Rayner Sulcoflex

T: time interval between surgeries in months;
R: refractive MIOL, D: diffractive MIOL
YAG: NdYAG laser capsulotomy performed after implantation of the first IOL (Y: yes; N: no)
BIL: bag-in-the-lens, BIL+S add: bag-in-the-lens and sulcular add multifocal IOL, I: iris fixated posteriorly to the iris, LIB: lens- in-the-bag, S: sulcus fixated

female. There were 11 (44%) right eyes (RE) and 14 (56%) left eyes (LE). Average age at the time of the second surgery was 64 ± 9 years (range 44 -76). *Table 2* summarizes the subjective visual complaints of the patients, the most common of which were blurred vision (9 eyes, 36%) and halos (7 eyes, 28%). Three patients presented ophthalmologic comorbidities: retinal detachment and glaucoma in one patient, anterior ischemic neuropathy in one patient and 1 patient had LASIK in the past. General comorbidities were found in 4 patients (23%), 3 of whom had a cardiovascular disease and 1 patient had epilepsy.

Table 2: *Subjective complaints (n=25)*

Complaint	**Prevalence**
Blurred vision	9 (36%)
Glare/halos	7 (28%)
Photophobia	1 (4%)
Loss of contrast sensitivity	1 (4%)
Aniseikonia/diplopia	2 (8%)
Multiple complaints	5 (20%)

The MIOLs used for the primary implantation (*Table 3*) were of a diffractive type in 22 eyes (88%) and of a refractive type in 3 eyes (12%). In all eyes the MIOL was implanted inside the

Table 3: *IOL data (25 eyes of 17 patients)*

IOL 1			IOL 2		
Type	**Number**	**D/R**	**Lens Position**	**Type**	**Number**
Alcon AcrySof ReSTOR	11 (44%)	D	Bag-in-the-lens	Morcher 89A	16 (64%)
Acrytec Acri.Twin	4 (16%)	D	+ multifocal sulcular IOL	Rayner Sulcoflex	2 (8%)
Acrytec Acri.LISA	3 (12%)	D	Sulcular	Sulcular Fixation	4 (16%)
AMO Tecnis	2 (8%)	D	Posterior iris-fixated	Ophtec Artisan Afakia	2 (8%)
3M style	2 (8%)	D	Lens-in-the-bag	Alcon Acrysof SA60AT	1 (4%)
AMO Rezoom	2 (8%)	R			
AMO Array	1 (4%)	R			

capsular bag and Nd:YAG laser capsulotomy was performed in 6 out the 25 eyes (24%).
The MIOL exchange was performed after an average period of 31 ± 53 months (range 2 - 216 months) (*Table 3*). Depending on the structural integrity of the capsular bag, the bag-in-the-lens (Morcher 89A) was the preferred monofocal IOL implanted (18 eyes). In cases where the capsular integrity was compromised an in-the-bag IOL (1 eye), a sulcus fixated (4 eyes) or an iris fixated (2 eyes) monofocal IOL was implanted. In two eyes, a sulcular additional multifocal IOL (Sulcoflex multifocal, Rayner) was placed in piggy back with a monofocal bag-in-the-lens.
The main peroperative complication was vitreous prolapse necessitating anterior vitrectomy in 4 eyes (16%); 3 of which had preoperative Nd:YAG laser capsulotomy. In 1 eye a peroperative choroidal bleeding occurred. No other per- or postoperative complications were observed. None of the patients had CME. One of the Sulcoflex piggy-back IOLs needed to be removed after 6 months because of unsatisfactory quality of vision.

Table 4 shows the parameters describing quality of vision in the patients as found prior to lens exchange and at the last postoperative follow-up, which was on average 13 months postoperatively (range 1 – 42 months). The preoperative glare was 1.34 ± 0.37 log units (range 0.76 – 2.21) and was for most individual patients well above the age 65-normal level of 1.15 (18).
The BCVA improved significantly after MIOL exchange from 0.77 ± 0.24 to 0.96 ± 0.11 (25 eyes, paired *t* test, $P < 0.001$) and so did the BCVA that improved from 0.36 ± 0.10 (0.3/0.8) to 0.53 ± 0.16 (0.3/0.5) (16 eyes, $P < 0.001$). The difference between targeted and achieved refraction (spherical equivalent) was -0.17D ± 0.57D (range -0.5D to +1.25D). Subjective complaints of blurred vision disappeared in all eyes after MIOL exchange, except in the eye with the Sulcoflex Add-on lens that needed explantation later on.

For the wavefront aberrations, it was seen that the total RMS (RMS_{tot}) increased non-significantly after exchange from 1.066 ± 0.371 μm to 1.398 ± 0.662 μm (7 eyes, paired t test, $P > 0.05$). The higher order RMS (RMS_{HO}) increased significantly from 0.350 ± 0.159 μm to 0.481 ± 0.139 (7 eyes, $P < 0.01$) which was mainly related to the spherical aberration of which the RMS increased significantly from 0.107 ± 0.051 μm to 0.261 ± 0.063 μm (7 eyes, $P < 0.01$). The coma RMS did not show any increase (Preop: 0.199 ± 0.086 μm; postop: 0.202 ± 0.116 μm; 7 eyes, $P > 0.05$).

DISCUSSION

These results show that patients implanted with MIOL suffering from a severe decrease in quality of vision due to blurred vision, glare, halos, photophobia and diplopia, can benefit considerably from an IOL exchange. This leads to a significantly improved corrected visual acuity, both for distance and near vision. The main drawback for this MIOL exchange to a monofocal IOL is that the patient no longer has a built-in reading correction, necessitating the use of reading spectacles. For those patients whom spectacle independence was the initial motivation for having a multifocal IOL implanted this outcome was perceived as very disappointing

Table 4: *Pre- and postoperative data available: glare, distance corrected visual acuity, targeted and achieved refraction, near corrected visual acuity, RMS total, spherical aberrations, coma and high order aberrations*

Patient	Glare (log)	BCVA (Dec)		Refraction (D)		NCVA (Dec)		RMS Total (µm)		RMS HO (µm)		RMS SA (µm)		RMS Coma (µm)	
Nr	Preop	Preop	Postop	Targeted	Achieved	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
1		1.0	1.0	0	-0.5	0.37	0.47	1.173	1.350	0.387	0.623	0.182	0.298	0.161	0.295
		1.0	1.0	0	-0.75	0.47	0.47	0.638	1.339	0.321	0.371	0.143	0.309	0.240	0.049
2	1.21	0.7	1.0	0	-0.5	0.47	0.47	0.919	1.324	0.659	0.687	0.134	0.236	0.308	0.392
	1.28	0.7	0.7	0	0	0.30	0.30	0.647	1.128	0.402	0.558	0.079	0.227	0.302	0.119
3	2.21	0.4	0.7					0.752		0.240		0.027		0.160	
4	1.36	1.0	1.0	0	0	0.24	0.47	0.479		0.235		0.027		0.065	
5	1.2	1.0	1.0	-1	-1.5			0.506		0.354		0.096		0.152	
6	1.43	1.0	1.0	0	0	0.47	0.47	0.652		0.344		0.112		0.129	
7	1.26	1.0	1.0	0	0		0.75	1.203	0.605	0.274	0.361	0.066	0.146	0.154	0.209
	1.07	0.9	1.0	0	0	0.30	0.75	0.839		0.313		0.043		0.213	
8	1.56	0.3	1.0	0	0	0.30	0.47								
9	1.62	1.0	1.0	0	0	0.47	0.94	1.408		0.372		0.166		0.128	
10		0.4	1.0	-1	-1	0.24	0.60								
11	1.7	0.7	1.0	0	-0.5	0.37	0.60	1.105		0.292		0.119		0.137	
12		1.0	1.2	0	0		0.60	1.132	2.777	0.166	0.352	0.032	0.282	0.083	0.128
		0.9	1.0	0	1.25		0.75	1.725	1.267	0.244	0.419	0.110	0.330	0.144	0.220
13		0.4	1.0	0	-2	0.15	0.60	1.563		0.458		0.087		0.196	
	1.58	0.3	1.0	0	0	0.37	0.60	2.715		1.108		0.431		0.525	
14		0.8	0.8	0	0	0.47									
		0.8	0.8	0	-0.5	0.47									
15	1.14	0.6	0.8	0	0	0.30	0.60	0.913		0.375		0.069		0.206	
		0.7	1.0	0	0		0.47	2.039		0.240		0.037		0.177	
16		1.0	1.0	0	0		0.47	2.029		0.156		0.013		0.081	
17	0.76	0.9	1.0	0	-0.5	0.47	0.47		1.670		0.555		0.334		0.160
	0.76	0.7	1.0	0	0.5	0.47	0.24								

D: diopters; Dec: visual acuity in decimal notation; RMS: root-mean-square; SA: spherical aberration; HO: higher order

and were proposed to have a removable sulcus positioned additional multifocal IOL implanted in the same surgical time. One patient experienced no subjective improvement of the preoperative complaints after this combined procedure and requested removal of the additional MIOL.

When spectacle independence is important, monovision is also an option. This approach creates monocular far and near vision. Although this avoids problems caused by MIOL design, a decrease in stereopsis, contrast sensitivity and visual field has been reported (19,20).

The preoperative measurement of patients' subjective complaints are of utmost importance and should include: refractive errors like hyperopic shift and ametropia, decentration/tilt, increased glare, and aberrometry. Based on these preoperative tests, MIOL exchange can be proposed if spectacle correction, contact lens wear, or surface laser treatment are no further options to help the patient more conservatively.

Postoperative wavefront analysis was only performed in cases with suboptimal results. The increase in wavefront aberrations can be explained by diminished quality of vision after two surgical procedures or the exchange of mainly aspherical IOLs for spherical monofocal IOLs.

Concerning the MIOL exchange surgical technique, it should be emphasized that dissection of the IOL and proper peeling of the capsular bag are difficult but important steps to achieve a stable and optimal result (11,17). The preferred technique of IOL implantation is in our hands the bag-in-the-lens which in primary intervention allows for sizing of the anterior capsulorhexis (21) and IOL centration by averaging the Purkinje reflections (22). In secondary interventions, centration with bag-in-the-lens is impossible, which leads to reduced quality of vision. In most eyes with prior Nd:YAG laser capsulotomy, an anterior vitrectomy is necessary to be performed due to vitreous loss because of rupture of the anterior vitreous face by the YAG laser (14). Complications are rare but can always occur. In our series we had one peroperative choroidal hemorrhage.

In conclusion, exchange was feasible and resulted in an improvement in patient's visual acuity and quality of image.

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