European Journal of Ophthalmology / Vol. 17 no. 4, 2007 / pp. 579-587

A survey of intraocular lens explantation: A retrospective analysis of 23 IOLs explanted during 2005

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PURPOSE. *To evaluate the indications, lens styles, perioperative findings, and results of intraocular lens (IOL) explantation or exchange performed in the authors department in 2005.*
METHODS. *The retrospective analysis comprised 22 patients (23 eyes). Twenty-one eyes had previous phacoemulsification and IOL implantation, one eye secondary aphakic IOL, and one eye phakic IOL implantation. The indications for IOL explantation/exchange and perioperative complications were evaluated. The best-corrected visual acuity (BCVA) before and after surgery was compared.*
RESULTS. *Time from initial surgery to explantation/exchange varied from 1 to 121 months, median value was 46 months. The IOLs were explanted using local anesthesia and in 21 eyes replaced with new lens. Indications for IOL removal were opacification of the IOL in 12 eyes, malposition of the IOL in 5 eyes, postoperative refractive error in 2 eyes, recurrent toxic anterior segment syndrome in 1 eye, pseudophakic dysphotopsia in 1 eye, endothelial cell loss in phakic anterior chamber IOL in 1 eye, and visual discomfort with intraocular telescopic lens in 1 eye. The mean BCVA (decimal scale) before and after IOL explantation/exchange was 0.562±0.279 and 0.627±0.276, respectively. There was no significant difference in visual acuity before and after IOL exchange (Wilcoxon test).*
CONCLUSIONS. *The most frequent indications for IOL explantation/exchange were opacification of the IOL and IOL malposition. Surgeries were uneventful in most cases. Final visual results have been largely good. Long-term follow-up of patients with various types of IOLs should be maintained. (Eur J Ophthalmol 2007; 17: 579-87)*

KEY WORDS. *Explantation, Indications, Intraocular lens, Results*

Accepted: February 3, 2007

INTRODUCTION

Cataract surgery has evolved recently along with the development of intraocular lenses (IOLs). Designs and materials of IOLs have changed considerably during the past several decades from early iris-fixated and anterior chamber IOLs to modern posterior chamber and foldable lenses. There were 1548 intraocular implants produced by 33 manufacturers available for use by ophthalmic surgeons as of January 2004 (1) and the number is growing. In addition to the standard anterior chamber (AC) and posterior chamber (PC) IOLs used after cataract surgery, there are phakic lenses, occluder lenses, iris-fixated lenses, toric lenses, telescopic lenses, aspheric lenses, multifocal lenses, accommodative lenses, and other types of IOLs. There are also nonlenticular implants such as tension capsular rings (CTRs) and spacers.

If the main chemical components are analyzed, IOL materials can be divided into two groups: acrylate/methacrylate polymers and silicone elastomers. The first group

 1120-6721/579-09$15.00/0

contains rigid PMMA IOLs and the foldable acrylic IOLs (both hydrophilic and hydrophobic) that have been developed by altering the side groups of the standard methacrylate polymer backbone. Because of their various components, they differ in refractive indices, water content, folding and unfolding behavior, and surface properties. The hydrophilicity of the IOL depends on the water contact angle in air; the lower this value, the more hydrophilic the IOL surface (2).

Early generations of IOLs often had severe complications associated with them, such as pseudophakic bullous keratopathy, uveitis-glaucoma-hyphema syndrome, and chronic cystoid macular edema (3, 4). Over the past 15 years an increase in the use of small incision cataract surgery and foldable IOLs has been seen. The actual numbers and percentages of lens explantations as well as reported complications vary with many factors. Decentration or dislocation was the leading reason for explantation during the past year according to the results of the seventh annual survey conducted by the European Society of Cataract and Refractive Surgeons (ESCRS) and the American Society of Cataract and Refractive Surgery (ASCRS) (5). Another very common indication for IOL exchange is the postoperative opacification of some currently available IOLs. There are several reports of early and late postoperative opacification of hydrophilic acrylic IOLs (6-11). Incorrect lens power and glare and optical aberrations are other frequently reported reasons for IOL explantation or exchange (12, 13).

In the present study, we survey the indications, lens styles, perioperative findings, clinical outcome, and visual results of 23 IOL explantations/exchanges performed during 2005 at the Department of Ophthalmology, University Hospital, Hradec Králové.

PATIENTS AND METHODS

Twenty-two patients (23 eyes) with visual or other subjective or objective ophthalmic problems that required lens exchange were recruited. Data collected included patient age, sex, and the eye involved. Detailed histories, including ophthalmic and systemic, were taken. The patients' charts were reviewed for preexisting ocular pathology, uncorrected visual acuity (UCVA), and best-corrected visual acuity (BCVA) before and after IOL explantation or exchange. Operative details on the date of surgery, type of anesthesia, IOL model and power (both explanted and replacement lenses), surgical method, and complications were retrieved. Table I shows the patients' data. All patients provided informed consent for the IOL explantation or exchange.

All patients had a detailed ophthalmic examination including measurement of UCVA, BCVA, intraocular pressure (IOP), slit-lamp evaluation after pupil dilation, and fundus evaluation. Visual acuity was measured using the Snellen scale at 6 meters and converted to the decimal scale. Data are presented as means ± standard deviations (SD). Statistical analysis of differences in BCVA before and after IOL explantation/exchange was performed using the Wilcoxon signed-rank test (nonparametric analogy of the the *t*-test).

The mean age of the 22 patients at the time of IOL explantation/exchange was 64.86±10.85 (SD) years (range 46 to 86 years). Six eyes (Patients 1, 13, 16, 17, 18, 19) had preexisting myopia gravis, one of them (Patient 13) with zonular damage. Two of the myopic eyes (Patients 17, 18) have undergone previous corneal refractive surgery. Another eye (Patient 10) had preexisting diabetic retinopathy, one eye (Patient 21) stable dry type age-related macular degeneration (AMD), and one eye (Patient 11) clinically significant synchysis scintillans. One eye (Patient 14) suffered injury in childhood (in 1955 at age 6) and had preexisting aphakia.

RESULTS

The initial IOL implantations were performed in 21 eyes (20 patients) at the Department of Ophthalmology, University Hospital, Hradec Králové. Two eyes (Patients 11 and 16) had the first IOL implantation in two other surgical centers in the Czech Republic. The initial surgery was phacoemulsification with PC IOL implantation in 20 eyes. Capsular tension ring (CTR) was inserted in one of these eyes (Patient 13) with myopia gravis and zonular damage. In one eye (Patient 21) the intraocular miniaturized telescope IMT^{TM} VisionCare was implanted in the bag after standard phacoemulsification. Perioperative complications occurred in one eye (Patient 16) that developed posterior capsule rupture. Anterior vitrectomy was performed and the IOL was placed in the sulcus.

In one case (Patient 14) secondary PC IOL implantation in the eye with posttraumatic aphakia was performed in 1998. The lens was placed in the sulcus and anterior vitrectomy was done. This patient developed early decen-

tration of the IOL and reposition was performed on the next day. Ten months later IOL decentration reappeared and reposition with transscleral suture of the IOL was performed. Sixteen months after the secondary IOL implantation this patient underwent trabeculectomy with mitomycin C due to secondary glaucoma. One eye (Patient 19) underwent uneventful implantation of angle supported phakic AC IOL.

After this, all patients developed visual symptoms or other ophthalmic problems significant enough to justify lens explantation or exchange for another IOL.

The IOLs were explanted/exchanged in the right eye in 11 patients, the left eye in 10 patients, and both eyes in 1 patient. Time from initial surgery to explantation/exchange varied from 1 month to 121 months, median value was 46 months.

Indications for IOL explantation/exchange were opacification of the IOL in 12 eyes (Patients 1–11), decentration-dislocation of the PC IOL in 5 eyes (Patients 12–16), incorrect lens power in 2 eyes (Patients 17, 18), endothelial cell loss in phakic AC IOL in 1 eye (Patient 19), recurrent toxic anterior segment syndrome (TASS) in 1 eye (Patient 20), visual discomfort with intraocular telescopic lens in 1 eye (Patient 21), and glare and halo effects in 1 eye (Patient 22).

The explantation/exchange were performed using local anesthesia in all cases. Surgical technique depended on the type of the IOL, preoperative ocular status, and perioperative findings. In most cases when exchange of the PC IOL was made (Patients 1–11, 17, 18, and 22), hydro- or viscodissection was attempted to free the IOL from the capsular bag. The status of the capsular bag influenced the decision on the fixation site of the new IOL. Two eyes (Patients 6 and 11) developed zonular dehiscence and the next IOL was placed in the anterior chamber (angle supported AC IOLs). In those two eyes anterior vitrectomy was performed. In one case (right eye of Patient 4) suction of secondary cataract was done.

In eyes with IOL decentration-dislocation (Patients 12–16) surgical technique varied from case to case. In one eye (Patient 12) asymmetric sulcus and bag fixation of the polymethylmethacrylate (PMMA) PC IOL with 5.2 mm optic was found. Because reposition of the IOL in the bag was impossible due to the fibrotic changes of the lens capsule and the position in the sulcus was unstable, the original PMMA lens with 5.2 mm optic was removed and replaced by PMMA PC IOL with 7.0 mm optic in the sulcus. In one eye (Patient 13) with preexisting myopia gravis and zonular damage the IOL and CTR were removed, anterior vitrectomy was performed, and no replacement lens was inserted. In one eye (Patient 14) with the history of trauma and previous multiple ophthalmic surgeries the PC IOL was easily removed, anterior vitrectomy was made, and the replacement lens was inserted in the anterior chamber and fixated on the iris (ARTISAN Aphakia). In one eye (Patient 15) broken haptic of the IOL was found during the exchange surgery, so the original IOL was removed and replaced with the same model of the IOL in the bag. In another eye with myopia gravis (Patient 16) PMMA PC IOL was removed, anterior vitrectomy was done, and the eye remained aphakic. Six months later secondary implantation of iris-fixated AC IOL was performed.

Phakic AC IOL (Patient 19) was simply removed from the anterior chamber. In an eye with recurrent TASS syndrome (Patient 20) the original IOL was removed and 6 months later the replacement lens (hydrophobic acrylic PC IOL) was implanted in the sulcus. The telescopic lens (Patient 21) was explanted within the capsular bag and angle fixated AC IOL was inserted. In all cases the viscoelastic devices were used and the wound was closed with 10-0 nylon suture.

Postoperative complications occurred in two cases. One eye (Patient 16) developed early postoperative wound leakage with hypotonia and choroidal ablation. Sutures (10-0 nylon) were added to close the wound and the ablation slowly disappeared. Another eye (Patient 22) developed secondary glaucoma. Medical therapy was insufficient in this case and trabeculectomy was performed 1 month after IOL exchange.

The mean BCVA (decimal scale) before and after IOL explantation/exchange was 0.562±0.279 and 0.627±0.276, respectively. There was no significant difference in visual acuity before and after IOL exchange (Wilcoxon test). Visual outcome following IOL exchange or removal showed that 10 eyes (43.5%) improved, 9 eyes (39%) had the same BCVA, and 4 eyes (17.5%) had worse BCVA postoperatively. Analysis of patient satisfaction with visual outcomes revealed that all patients who had lens exchange for IOL opacification were satisfied with the postoperative vision. Four patients with IOL malposition, two with incorrect lens power, and one with recurrent TASS were also very satisfied with the postoperative clinical outcome. Patients 16, 19, and 21 were not fully satisfied. Patient 22 was satisfied despite the worsening of BCVA.

TABLE I - PATIENT DATA

								VA preop		VA postop		
Patient	**Sex**	**Age, yr**	**Eye**	**Time**	**Indication**	**Original IOL**	**New IOL**	**UC**	**BC**	**UC**	**BC**	**Comments**
1	F	69	R	2	IOL opacification	Allergan SI30NB +11.0	AcrySof MA60BM +12.0	0.16	0.16	0.32	0.8	Myopia gravis
2	M	57	R	48	IOL opacification	AquaSense +22.0	LiteFlex +22.0	0.9	0.9	0.9	0.9	
3	F	65	L	45	IOL opacification	AquaSense +24.0	Hanita B-LENS +24.0	0.8	0.8	0.8	0.8	
4	F	70	R	48	IOL opacification	AquaSense +24.0	Hanita B-LENS +22.0	0.25	0.32	0.25	0.9	Suction sec cat
			L	46	IOL opacification	AquaSense +24.0	Hanita B-LENS +22.0	0.32	0.5	0.5	0.9	
5	M	75	L	49	IOL opacification	AquaSense +21.0	AcrySof MA60BM +21.0	0.5	1.0	0.63	1.0	
6	M	70	L	45	IOL opacification	AquaSense +24.0	LENSTEC LA-501 +22	0.8	0.8	0.8	0.8	
7	M	62	L	49	IOL opacification	AquaSense +22.0	Hanita B-LENS +22.0	0.125	0.7	0.125	0.7	
8	M	71	R	53	IOL opacification	AquaSense +24.0	Hanita B-LENS +24.0	0.32	0.5	0.4	0.5	
9	M	60	L	57	IOL opacification	AquaSense +22.0	Liteflex +22.0	0.63	0.63	0.63	0.63	
10	F	86	L	60	IOL opacification	AquaSense +23.0	Hanita B-LENS +23.0	HM	HM	0.1	0.1	DR
11	M	79	L	40	IOL opacification	Ophthalmed ACRLC160 +19.5	LENSTEC LA-501 +16.0	0.4	0.5	0.4	0.5	Synchysis scintillans
12	F	80	L	6	IOL malposition	Medicontur 500MP +20.0	ERILENS 76P +20	0.1	0.2	0.2	0.8	
13	F	73	R	72	IOL malposition	Cilco M2 60M -2.0 +CTR	0	0.1	0.1	0.2	0.2	Myopia gravis, zon. damage
14	M	56	R	86	IOL malposition	Allergan PC58 NB +19.0	ARTISAN Aphakia +14.0	0.01	0.6	0.4	0.7	Traumatic aphakia

continued

TABLE I - PATIENT DATA

								VA preop		VA postop		
Patient	**Sex**	**Age, yr**	**Eye**	**Time**	**Indication**	**Original IOL**	**New IOL**	**UC**	**BC**	**UC**	**BC**	**Comments**
15	F	52	R	6	IOL malposition	Bausch&Lomb LI61SE +22.0	Bausch&Lomb LI61SE +22.0	0.1	0.4	0.4	0.63	Defect of one haptic
16	M	48	L	121	IOL malposition	ERILENS NH74 -10.0	ARTISAN Myopia -7.0	0.2	0.32	0.05	0.05	Myopia gravis
17	F	57	R	1	Postoperative refractive error	AcrySof MA60BM +23.0	AcrySof MA60BM +30.0	0.2	0.9	0.9	0.9	PRK 1996
18	F	46	R	4	Postoperative refractive error	AcrySof SA60AT +21.0	AcrySof SA60AT +26.0	0.2	0.63	0.4	0.7	LASIK 1997
19	M	49	R	44	Endothelial cell loss	Phakic 6H130 -8.0	0	0.25	1.0	0.001	0.8	Myopia gravis
20	F	70	R	2	Recurrent TASS	ACQUA Mediphacos +18.0	AcrySof MA60BM +21.0	0.1	0.2	0.2	0.5	
21	M	67	R	72	Vision discomfort with IMT	Vision Care IMT	LENSTEC LA-501 +18.0	0.1	0.4	0.1	0.2	AMD
22	M	65	L	7	Disphotopsia, glare	SOFTEC I +17.0	SOFCRYL A 2000 DIAB +19.0	0.4	0.8	0.32	0.4	Secondary glaucoma

IOL = Intraocular lens; VA = Visual acuity; UC = Uncorrected; BC = Best-corrected; Sec cat = Secondary cataract; HM = Hand movement; DR = Diabetic retinopathy; CTR = Capsular tension ring; Zon. damage = Zonular damage; PRK = Photorefractive keratectomy; LASIK = Laser in situ keratomileusis; TASS = Toxic anterior segment syndrome; IMT = Intraocular telescopic lens; AMD = Age-related macular degeneration

DISCUSSION

Improvements in surgical techniques, manufacturing, and IOL styles have greatly reduced the incidence of major lens-related complications. However, many patients still develop postoperative problems that require IOL explantation or exchange. The preoperative ocular status of the patient is very important in deciding the final clinical outcome of explantation/exchange surgery. Patients with more severe preoperative ocular problems more often have a less satisfactory outcome after lens removal or exchange than those with milder problems.

In our series the most common reason for IOL explantation/exchange was postoperative opacification of the IOL. Of these 12 eyes Aqua-Sense IOLs were initially implanted in 10 eyes and other types in 2 eyes. The Aqua-Sense (Ophthalmic Innovations International) is a single-piece IOL manufactured from a hydrophilic acrylic copolymer with incorporated UV absorber. Cases of explanted opacified Aqua-Sense lenses were recently described (14) and perioperative complications of lens exchange were also reported (15). In our series of 10 eyes with Aqua-Sense the lens exchange and implantation of the new lens were uneventful in 9 eyes, where the new PC IOL was placed in the bag. Only 1 eye developed zonular dehiscence and the replacement lens was inserted in the anterior chamber. The visual acuity of our patients with opacified IOLs before lens exchange was surprisingly good in most eyes, even in cases with severe opacification. However, all patients reported deterioration in vision that required lens exchange. Apart from the 10 explanted Aqua-Sense IOLs during 2005, we had exchanged 9 other opacified

Fig. 1 - *Photomicrograph of sagittal section of the lens optic stained with the von Kossa method. Note the narrow band of positivity closely beneath the optical surface. Original magnification, 40x.*

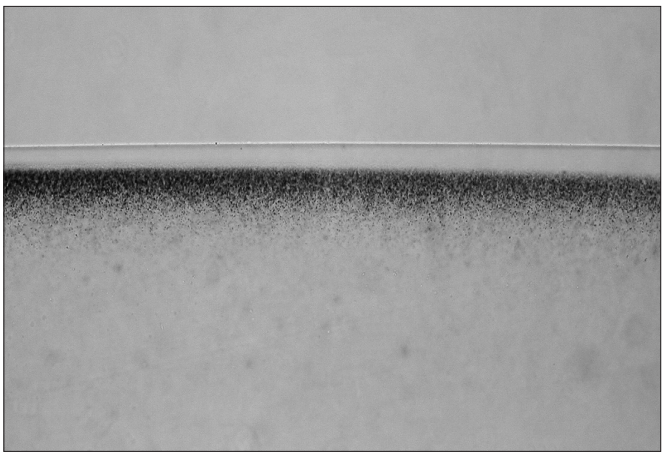

Fig. 2 - *Multiple tiny granular deposits concentrated beneath the lens optic surface. Note that the region immediately subjacent to the external optic surface is free of any deposits. von Kossa method, original magnification, 400x.*

Aqua-Sense IOLs during 2004 and we followed up 4 others that have not been exchanged yet. We are aware that all acrylics in use today are unique. Surface charge characteristics, contact-surface angle to water, and other factors affect an IOL's performance in the eye. Most of the currently available hydrophilic acrylic lenses are manufactured from different acrylic copolymers with water contents ranging from 18 to 28%, and an incorporated UV absorber. Although hydrophilic surface has been shown to lower the inflammatory cytologic response to the IOL, some currently available hydrophilic acrylic IOLs (not only AquaSense) have been associated with reports on late postoperative opacification caused by calcium precipitation (6-11).

In order to evaluate the pattern of opacification histologically, one of the explanted IOLs was fixed in 10% formalin, dehydrated, and embedded in paraffin. Sagittal sections through the lens optic were cut and stained using the von Kossa method for calcium. Calcium salts stain in brown to black with this staining technique. Microscopically, multiple tiny brown granules were present closely beneath the anterior surface of the lens optic. The granules were concentrated in continuous narrow band parallel to the curvature of the optic, sparing the region immediately subjacent to the external lens surface (Figs. 1 and 2). The edges of the lens, its posterior optic surface, as well as the inner optic region was free of any deposits. Positivity of the von Kossa staining method suggests that the granules represent the unique type of dystrophic calcification. The distribution pattern of calcium deposits was similar as described in the literature (14-17) except the absence of deposits beneath the posterior lens surface.

Malposition of the IOL was the second most common indication for lens explantation in our study. In one eye the reason was incorrect asymmetric bag and sulcus fixation performed during the initial procedure and in another one eye damage of one haptic of the original IOL was found during the exchange surgery. Centration of the IOL is considered to be related to many lens characteristics including design, total length, and optic and haptic materials (18). Several studies reported that an asymmetric capsulorhexis or any radial tear of anterior capsule possibly cause IOL decentration (19-21). Asymmetric bag–sulcus lens fixation (22) or broken haptics also lead to severe IOL dislocation. Three other eyes had preexisting ocular pathology. Two of them were highly myopic, one with preexisting zonular damage. The other eye (Patient 14) was a challenging case (traumatic aphakia and multiple previous surgeries) and excellent final visual outcomes demonstrate that with sophisticated surgical techniques and modern intraocular implants visual recovery may be achieved even in such complicated eyes.

Incorrect lens power remains a significant problem. It is important to have excellent IOL measurements. New biometry technologies are coming on-line that will help us to make more accurate measurements and choose the right IOL power. We use laser interferometry system IOL Master and also ultrasound biometry at our depart-

ment and the results are uniformly good. Both eyes with incorrect lens power in our study have undergone previous keratorefractive surgery: Patient 17 photorefractive keratectomy (PRK) and Patient 18 laser in situ keratomileusis (LASIK). In such eyes calculation of IOL power is difficult and it is necessary to use special measurements and formulas (23-27).

Phakic IOLs have proved to be a good alternative for surgical correction of myopic, hyperopic, and astigmatic refractive errors of the eye (28-32). Phakic refractive lenses encompass three categories based on the placement in the eye: one approach is implantation of the angle-supported AC IOLs; the two others are iris-supported and PC phakic IOLs. We have been using angle-fixated AC IOLs PHAKIC 6 for both hyperopia and myopia corrections since January 2000. Our results showed that the use of these lenses provides very good and stable refractive outcome. We follow up carefully endothelial cell density in all our patients with phakic AC IOLs and in this case the intraocular lens was removed because of continual endothelial cell loss.

Outbreaks of postoperative ocular inflammation are uncommon. The causes of those that occur can be infectious or noninfectious (sterile). An acute anterior segment inflammation after uneventful cataract surgery in which no infectious cause for the inflammation can be found is called TASS (33). Ten cases of TASS have been reported with the implantation of the MemoryLens (34). In our study one eye (Patient 20) developed anterior chamber inflammation with flare, fibrin exudate, and hypopyon 6 days after uneventful phacoemulsification and PC IOL (ACQUA Mediphacos) implantation, which subsided under topical and systemic antibiotic and steroid treatment. Over 2 months the patient experienced two other recurrences of anterior chamber inflammation, and all cultures were negative with no signs of infectious endophthalmitis. We decided to remove the IOL. The patient has improved and no other recurrences were observed. Six months later hydrophobic acrylic PC IOL was inserted in the sulcus. Although it is difficult to implicate with certainty the IOL itself as the source of sterile inflammation, the lack of any other obvious factor and improvement after its removal suggest that the cause could be related to the original IOL.

The use of IMT has been described by several authors (35-37). We performed four IMT^{TM} VisionCare implantation in patients with stable dry-type AMD during 2000. The results were good and this is the only case of explantation of IMT because of patient dissatisfaction.

Glare and optical aberrations are problems most commonly reported by patients with multifocal IOLs (38-45). In patients who underwent explantation of three-piece acrylic IOLs, glare and optical aberration were the most common reasons for removal (46). The exact cause of this glare after surgery is not certain, but the most likely explanation is related to the sharp or squared edge of the optic (47). Although we have been using multifocals (AMO Array, Alcon Restor) for several years and three-piece acrylics with sharp edge routinely, we have never performed removal of any of these lenses for glare or optical aberrations. In Patient 23 one piece hydrophilic acrylic foldable IOL with 5.75 mm optic was originally implanted. He reported seeing rings of light in the peripheral vision and his problems were subjectively so serious that the exchange for IOL with 7.0 mm optic was made. Despite decreased BCVA postoperatively and necessity to perform trabeculectomy due to secondary glaucoma, the patient was satisfied with the visual outcome.

There are many ways of avoiding lens-related complications and therefore decreasing the rate of IOL explantation/exchange (48). Most important, excellent surgical technique with an intact curvilinear capsulorhexis and proper placement of the IOL within the capsular bag are essential. In addition, careful folding, loading, and insertion of the IOL may eliminate many problems associated with damage to the implant, including tearing of the lens optic or damage to the lens haptics that require explantation. It is also very important to have excellent IOL measurements. New biometry technologies are coming online that will help us to make more accurate measurements and choose the right IOL power. Proper patient selection and preoperative counseling are important to ensure realistic expectations of patients. This is especially important in candidates for intraocular refractive surgery and in patients with preexisting ocular pathology. It is also necessary to maintain ongoing vigilance in following and monitoring any new IOL material and design because we need to be aware of late complications.

ACKNOWLEDGEMENTS

Supported in part by research project MZO 00179906.

None of the authors has a financial or proprietary interest in any product mentioned.

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REFERENCES

1. Holladay JT. International Intraocular Lens and Implant Registry 2004. J Cataract Refract Surg 2004; 30: 209-10.
2. Kohnen T. The variety of foldable intraocular lens materials. J Cataract Refract Surg 1996; 22 (Suppl): S1255-8.
3. Kraff MC, Sanders DR., Raanan MG. A survey of intraocular lens explantations. J Cataract Refract Surg 1986; 12: 644-50.
4. Doren GS, Stern GA, Driebe WT. Indications for and results of intraocular lens explantation. J Cataract Refract Surg 1992; 18: 79-85.
5. Mamalis N. Dislocation and decentration most common reasons for IOL explantation. Eurotimes 2006; 11: 33.
6. Apple DJ, Werner L, Pandey SK. Newly recognized complications of posterior chamber intraocular lenses. Arch Ophthalmol 2001; 119: 581-2.
7. Trivedi RH, Werner L, Apple DJ, et al. Post cataract-intraocular lens (IOL) surgery opacification. Eye 2002; 16: 217-41.
8. Pandey SK, Werner L, Apple DJ, et al. Calcium precipitation on the optical surfaces of a foldable intraocular lens: a clinicopathological correlation. Arch Ophthalmol 2002; 120: 391-3.
9. Werner L, Apple DJ, Escobar-Gomez M, et al. Postoperative deposition of calcium on the surfaces of a hydrogel intraocular lens. Ophthalmology 2000; 107: 2179-85.
10. Yu AKF, Ng ASY. Complications and clinical outcomes of intraocular lens exchange in patients with calcified hydrogel lenses. J Cataract Refract Surg 2002; 28: 1217-22.
11. Pandey SK, Werner L, Apple DJ, et al. Hydrophilic acrylic intraocular lens optic and haptics opacification in a diabetic patient. Ophthalmology 2002; 109: 2042-51.
12. Mamalis N, Crandall AS, Pulsipher MW, et al. Intraocular lens explantation and exchange. A review of lens styles, clinical indications, clinical results, and visual outcome. J Cataract Refract Surg 1991; 17: 811-8.
13. Mamalis N. Explantation of intraocular lenses. Curr Opin Ophthalmol 2000; 11: 289-95.
14. Izak AM, Werner L, Pandey SK, et al. Calcification of modern foldable hydrogel intraocular lens designs. Eye 2003; 17: 393-406.
15. Dagres E, Khan MA, Kyle GM, et al. Perioperative complications of intraocular lens exchange in patients with opacified Aqua-Sense lenses. J Cataract Refract Surg 2004; 30: 2569-73.
16. Yu AKF, Kwan KYW, Chan DHY, et al. Clinical features of 46 eyes with calcified hydrogel intraocular lenses. J Cataract Refract Surg 2001; 27: 1596-606.
17. Neuhann IM, Werner L, Izak AM., et al. Late postoperative opacification of a hydrophilic acrylic (hydrogel) intraocular lens. Ophthalmology 2004; 111: 2094-101.
18. Tetz MR, O'Morchoe DJC, Gwin TD, et al. Posterior capsular opacification and intraocular lens decentration. Part II: experimental findings on a prototype circular intraocular lens design. J Cataract Refract Surg 1988; 14: 614-23.
19. Ohmi S. Decentration associated with asymmetric capsular shrinkage and intraocular lens size. J Cataract Refract Surg 1993; 19: 640-3.
20. Assia EI, Apple DJ, Barden A, et al. An experimental study comparing various anterior capsulectomy techniques. Arch Ophthalmol 1991; 109: 642-7.
21. Caballero A., López MC, Losada M, et al. Long-term decentration of intraocular lenses implanted with envelope capsulotomy and continuous curvilinear capsulotomy: a comparative study. J Cataract Refract Surg 1995; 21: 287-92.
22. Jung CK, Chung SK, Baek NH. Decentration and tilt: Silicone multifocal versus acrylic soft intraocular lenses. J Cataract Refract Surg 2000; 26: 582-5.
23. Aramberri J. Intraocular lens power calculation after corneal refractive surgery: Double-K method. J Cataract Refract Surg 2003; 29: 2063-8.
24. Argento C, Cosentino MJ, Badoza D. Intraocular lens power calculation after refractive surgery. J Cataract Refract Surg 2003; 29: 1346-51.
25. Packer M., Brown LK, Hoffman RS, et al. Intraocular lens power calculation after incisional and thermal keratorefractive surgery. J Cataract Refract Surg 2004; 30: 1430-4.
26. Gimbel HV, Sun R, Furlong MT, et al. Accuracy and predictability of intraocular lens power calculation after photorefractive keratectomy. J Cataract Refract Surg 2000; 26: 1147-51.
27. Gimbel HV, Sun R. Accuracy and predictability of intraocular lens power calculation after laser in situ keratomileusis. J Cataract Refract Surg 2001; 27: 571-6.
28. Alió JL, de la Hoz F, Pérez-Santonja JJ, et al. Phakic anterior chamber lenses for the correction of myopia: a 7-year cumulative analysis of complications in 263 cases. Ophthalmology 1999; 106: 458-66.
29. Pérez-Santonja JJ, Iradier MT, Sanz-Iglesias L, et al.

Endothelial change in phakic eyes with anterior chamber intraocular lenses to correct high myopia. J Cataract Refract Surg 1996; 22: 1017-22.
30. Menezo JL, Cisneros A, Hueso JR, Harto M. Long-term results of surgical treatment of high myopia with Worst-Fechner intraocular lenses. J Cataract Refract Surg 1995; 21: 93-8.
31. Pallikaris IG, Kalyvianaki MI, Kymionis GD, et al. Phakic refractive lens implantation in high myopic patients: one-year results. J Cataract Refract Surg 2004; 30: 1190-7.
32. Menezo JL, Cisneros AL, Rodriguez-Salvador V. Endothelial study of iris-claw phakic lens: four year follow-up. J Cataract Refract Surg 1998; 24: 1039-49.
33. Monson MC, Mamalis N, Olson RJ. Toxic anterior segment inflammation following cataract surgery. J Cataract Refract Surg 1992; 18: 184-9.
34. Jehan FS, Mamalis N, Spencer TS, et al. Postoperative sterile endophthalmitis (TASS) associated with the MemoryLens. J Cataract Refract Surg 2000; 26: 1773-7.
35. Lipshitz I, Loewenstein, A, Reingewitz M, et al. An intraocular telescopic lens for macular degeneration. Ophthalmic Surg Lasers 1977; 28: 513-7.
36. Ka kalo lu M, Üretmen Ö, Ya ci A. Medium-term results of implantable miniaturized telescopes in eyes with age-related macular degeneration. J Cataract Refract Surg 2001; 27: 1751-5.
37. Alió JL, Mulet EM, Ruiz-Moreno AM, et al. Intraocular telescopic lens evaluation in patients with age-related macular degeneration. J Cataract Refract Surg 2004; 30: 1177-89.
38. Holladay JT, van Dijk H, Lang A, et al. Optical performance of multifocal intraocular lenses. J Cataract Refract Surg 1990; 16: 413-22 [erratum 781].
39. Steinert RF, Aker BL, Trentacots 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: 1243-55.
40. 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: 589-99.
41. Steinert RF, Post CT Jr, Brint SF, et al. A prospective, randomized, double-masked comparison of a zonal-progressive multifocal intraocular lens and a monofocal intraocular lens. Ophthalmology 1992; 99: 853-60; discussion by Holladay JT, 860-1.
42. Vanquero-Ruano M, Encinas JL, Millan I, et al. AMO Array multifocal versus monofocal intraocular lenses: long-term follow-up. J Cataract Refract Surg 1998; 24: 118-23.
43. Duffey RJ, Zable RW, Lindstrom RL. Multifocal intraocular lenses. J Cataract Refract Surg 1990; 16: 423-9.
44. Keates RH, Pearce JL, Schneider RT. Clinical results of the multifocal lens. J Cataract Refract Surg 1987; 13: 557-60.
45. Vaquero M, Encinas JL, Jimenez F. Visual function with monofocal versus multifocal IOLs. J Cataract Refract Surg 1996; 22: 1222-5.
46. Mamalis N. Complications of foldable intraocular lenses requiring explantation or secondary intervention—1998 survey. J Cataract Refract Surg 2000; 26: 766-72.
47. Schwiegerling J. Recent developments in pseudophakic dysphotopsia. Curr Opin Ophthalmol 2006; 17: 27-30.
48. Mamalis N. Explantation of intraocular lenses. Curr Opin Ophthalmol 2000; 11: 289-95.